

ARCS

The ARES Arms & Munitions Classification System

Edited by N.R. Jenzen-Jones



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THE ARES ARMS & MUNITIONS
CLASSIFICATION SYSTEM



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About Armament Research Services

Armament Research Services (ARES) is a specialist technical intelligence consultancy, offering expertise and analysis to a range of government and non-government entities in the arms and munitions field. ARES fills a critical market gap, and offers unique technical support to other actors operating in the sector. Drawing on the extensive experience and broad-ranging skillsets of our staff and contractors, ARES delivers full-spectrum research & analysis, technical review, training, and project support services. Our services are often delivered in support of national, regional, and international initiatives, and can be conducted in both permissive and non-permissive environments.

Safety Information

Remember, all arms and munitions are dangerous. Treat all firearms as if they are loaded, and all munitions as if they are live, until you have personally confirmed otherwise. If you do not have specialist knowledge, never assume that arms or munitions are safe to handle until they have been inspected by a subject matter specialist. You should not approach, handle, move, operate, or modify arms and munitions unless explicitly trained to do so. If you encounter any unexploded ordnance (UXO) or explosive remnants of war (ERW), always remember the 'ARMS' acronym:

AVOID the area

RECORD all relevant information

MARK the area to warn others

SEEK assistance from the relevant authorities

Disclaimer

This report is presented for informational purposes only. It is not intended to provide instruction regarding the construction, handling, disposal, or modification of any weapon systems. Armament Research Services (ARES) strongly discourages non-qualified persons from handling arms and munitions. Arms or munitions of any variety should not be handled without the correct training, and then only in a manner consistent with such training. Subject matter experts, such as armourers, ATOs, and EOD specialists, should be consulted before interacting with arms and munitions. Make a full and informed appraisal of the local security situation before conducting any research related to arms or munitions.

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Abbreviations & Acronyms

ACP	Automatic Colt Pistol [cartridge]
AMI	Arms and munitions investigation
ARCS	(ARES) Arms & Munitions Classification System
ATGM	Anti-tank guided missile
ATGW	Anti-tank guided weapon
BCU	Battery coolant unit
CO₂	Carbon dioxide
CREWPADS	Crew-portable air defence system
CW	Chemical weapons
DEW	Directed-energy weapon
DMR	Designated marksman rifle
F&F	Fire and forget
GPMG	General-purpose machine gun
HMG	Heavy machine gun
IED	Improvised explosive device
ITI	International Tracing Instrument
LMG	Light machine gun
LR	Long Rifle [cartridge]
LWMMG	Lightweight Medium Machine Gun
MANPADS	Man-portable air defence system
MCLOS	Manual command to line-of-sight
MMG	Medium machine gun
NATO	North Atlantic Treaty Organization
NGO	Non-governmental organisation
PDW	Personal defence weapon
PGE-SA	Panel of Governmental Experts on Small Arms
RCA	Riot control agent
S&W	Smith & Wesson
SACLOS	Semi-automatic command to line-of-sight
SALW	Small arms and light weapons
SMG	Sub-machine gun
SSM	Surface-to-surface missile
SAM	Surface-to-air missile

Introduction

N.R. Jenzen-Jones

Overview

Correctly defining, classifying, and identifying weapons and their ammunition is a fundamental part of many arms and munitions investigations (AMIs). Whilst related, these three operations are distinct. Nonetheless, all rely upon the precise and consistent use of terminology. Similarly, a clear and logical classification schema is a critical tool in ensuring the consistent application of terminology. The consistent use of precise definitions enables clearer communication on technical topics, allowing all correspondents to remain on the same proverbial page. It also enables precise, concise, and meaningful reporting. The ARES Arms & Munitions Classification System (ARCS), presented herein, seeks to provide both a clear, easy-to-use classification schema, and a series of intensional definitions which use the physical and mechanical characteristics of weapons as the *fundamenta divisionis* (Lat., ‘the basis of division’).¹ The report also includes an extensive glossary. This public release of ARCS focuses exclusively on the Small Arms and Light Weapons classes, but ARES is continuing to work towards developing similar materials for Heavy Weapons and Munitions—some of which are already being used internally and in work for clients.

The identification of small arms and light weapons (SALW) by make and model has long been the subject of specialist literature, but the definition and classification of these items has received only sporadic—and often limited or incomplete—attention. At the time of publication, there is no universally accepted definition of a ‘small arm’ or of a ‘light weapon’. Perhaps surprisingly, there has been relatively minimal effort on the part of international organisations to define these high-level terms more precisely, or to define the types of weapons which comprise these broad classes. Rather, such organisations have generally either deferred to national definitions, or relied upon international definitions which only classify weapons under one or two broad classes.² Nor have international organisations yet worked to develop a classification schema which clearly expresses how different types of arms or munitions are related.

The development of definitions in different contexts, for different purposes, means that there is often inconsistency between terminology used by different groups. Military manuals, law enforcement outputs, academic publications, manufacturers’ documentation, national legislation, and multilateral instruments often define SALW in substantively different ways. At the international level, within the framework of the United Nations (UN) small arms process, the International Tracing Instrument (ITI)³

1 Rather than, for example, incidental cosmetic characteristics or the manner in which a weapon is typically employed.

2 Weapons are often grouped under ‘small arms’ or ‘light weapons’, offering a very limited basis for division. Sometimes these definitions are even less specific, with ‘small arms and light weapons’ considered and defined as a whole. The International Tracing Instrument, for example, mostly addresses these two broad classes of arms together, latterly offering largely extensional definitions with incomplete lists of examples for each class (UNGA, 2005a).

3 Properly, the International Instrument to Enable States to Identify and Trace, in a Timely and Reliable Manner, Illicit

provides the most authoritative definition of SALW (Jenzen-Jones & Schroeder, 2018). It reads:

“For the purposes of this instrument, “small arms and light weapons” will mean any man-portable lethal weapon that expels or launches, is designed to expel or launch, or may be readily converted to expel or launch a shot, bullet or projectile by the action of an explosive, excluding antique small arms and light weapons or their replicas. Antique small arms and light weapons and their replicas will be defined in accordance with domestic law. In no case will antique small arms and light weapons include those manufactured after 1899:

(a) “Small arms” are, broadly speaking, weapons designed for individual use. They include, inter alia, revolvers and self-loading pistols, rifles and carbines, sub-machine guns, assault rifles and light machine guns;

(b) “Light weapons” are, broadly speaking, weapons designed for use by two or three persons serving as a crew, although some may be carried and used by a single person. They include, inter alia, heavy machine guns, hand-held under-barrel and mounted grenade launchers, portable anti-aircraft guns, portable anti-tank guns, recoilless rifles, portable launchers of anti-tank missile and rocket systems, portable launchers of anti-aircraft missile systems, and mortars of a calibre of less than 100 millimetres”.

(UNGA, 2005a, para. 4).

Whilst the ITI defines the umbrella term ‘small arms and light weapons’, it does not attempt to further define the types of weapons that these terms encompass, merely providing a list of examples, couched in the terms “broadly speaking” and “inter alia”. These examples exclude many common terms applied to SALW, perhaps most notably in omitting any reference to shotguns. In addition to this broader ambiguity, some of the specific examples provided within the ITI are problematic from a definitional

standpoint. These include “assault rifles”—a term which is notoriously difficult to clearly define⁴—and “portable anti-aircraft guns”, almost all of which are so heavy as to make their inclusion in the category of light weapons unlikely. Other terms used in the ITI definition make little sense in plain English, much less technical language (e.g., “portable launchers of anti-tank missile and rocket systems”) (ARES, 2016). Whilst the chapeau of the ITI text covers most modern small arms and light weapons, there remain notable omissions of extant (e.g., flamethrowers, CW dispersal devices) and emergent/horizon technologies (e.g., directed-energy weapons, railguns). More importantly, however, the absence of further divisions for SALW leaves the international discourse without a clear set of granular definitions to rely upon. It is the latter definitions that are the most useful for conducting AMLs and pursuing the day-to-day business of many organisations, and the absence of clear and precise language is a detriment to international cooperation on such topics.⁵

The use of correct and consistent definitions and descriptors can mitigate problems with communication, and ensure that all relevant parties remain ‘on the same page’. This can be of particular benefit when communication takes place between different contexts (e.g., a museum curator communicating with a lawyer, or a military end-user communicating with a customs agent). Precision in language also enables precise, concise, and meaningful reporting, which is as important in articles intended for lay readers as it is in academic or technical publications. ARCS is not intended to replace existing definitions and descriptions of SALW wholesale. In certain contexts, such as in the armed forces, role-based terminology remains appropriate and helps to convey important information to non-specialist audiences. This terminology will typically evolve over time, with the obsolescence of some weapons and the introduction of others. In the broader international context for which ARCS has been developed, however, the broad employment of a standardised set of definitions—revised periodically—would be of tremendous value.

Despite the many benefits of employing precise and accurate terminology, the erroneous use of terms related to weapons and ammunition is commonplace (Jenzen-Jones & Schroeder, 2018; Jenzen-Jones, 2021a). For example, the term ‘automatic’ is often used incorrectly as a synonym for ‘semi-automatic’,⁶ and the term ‘bullet’ is often incorrectly substituted for ‘cartridge’. As a result of non-technical contexts surrounding the discussion of firearms—particularly in politics and popular media—

4 See, for example: Jenzen-Jones, 2021a: “The term ‘assault rifle’ was coined in Germany during the second world war (the English-language term being adapted from the German *sturmgewehr*) as an appellation for a series of compact automatic rifles firing [rifle] cartridges of a reduced length. ... Assault rifles are a specific sub-set of self-loading rifles (and, more specifically, of automatic rifles). Whilst assault rifles can be defined ... ambiguities remain with all definitions ... ‘assault rifle’ can be considered a role-based term and its use is therefore not recommended, except in specific contexts.” Generally, the terms ‘self-loading rifle’ or ‘automatic rifle’ may be preferred.

5 This has been communicated to the editor and authors by a variety of specialists in related fields, and is evidenced by the numerous research works on definitions which ARES has been commissioned to undertake on behalf of a range of international actors over the past seven years.

6 Both historically and to present day, the terms ‘auto’, ‘auto-loading’, and ‘autoloading’ have sometimes been used to describe semi-automatic (self-loading) actions, confusing matters even further.

incorrect or nebulous terminology has sometimes seen widespread usage. Similarly, the needs of legal, military, and commercial entities have historically resulted in terminology that has diverged from that used by arms specialists. Many of these terms are imprecise and may cause confusion where they intersect with technical language. For example, the U.S. government uses a definition of ‘machine gun’ which encompasses all automatic weapons—even handguns and shotguns, the automatic variants of which would never be considered machine guns by most technical specialists. The same is true of key components for such weapons, which are categorised as ‘machine guns’ in their own right in the interests of legal expedience.⁷

The primary purpose of the ARES Arms & Munitions Classification System (ARCS) is to present a set of universally applicable definitions for SALW which will convey the maximum amount of useful and practical information to the observer. These definitions are supported by a classification schema which organises the definitions hierarchically, into several categories of SALW, and by an extensive glossary of technical terminology.

The classification schema and definitions have been developed specifically for use at the international level, however they are also suitable for a broad range of other purposes. At the national level, for example, ARCS could be applied to reports generated by forensic science providers or police units, ensuring consistency of terminology and ease of understanding by readers regardless of background.

At the time of publication, ARCS definitions are already being used by a variety of non-governmental organisations (NGOs), museums, private companies, and academics operating around the world at both the national and international levels. Further academic exploration of the principles underlying ARCS will be published in the future. Implementation tools will be made available via the ARES website in due course, and ARES is offering—at no charge—a short online training course to organisations interested in implementing ARCS.⁸

7 See GPO, n.d., para. 5845(b).

8 Commencing Q4 2022. For details, see: www.armamentresearch.com/ARCS

Scope

ARCS provides a set of working definitions addressing the internationally important, overarching terms ‘small arms’, ‘light weapons’, ‘heavy weapons’, and ‘munitions’ (these reflecting the four ARCS Classes, discussed below), as well as the most common categories of weapons that fall under the Small Arms and Light Weapons Classes. These definitions are supported by explanatory text that is founded in a historical and contemporary literature review, a multi-domain assessment of extant terminology, and consultation with numerous subject-matter experts. More than twenty specialists from a range of disciplines were consulted during this research. These include arms and munitions specialists; national and international lawyers and policymakers; experienced personnel in the military, law enforcement, intelligence, and manufacturing sectors; and academics, researchers, and other members of civil society. It is intended that ARCS should exist as a ‘living’ document which will be periodically reviewed and updated to reflect changes in real-world usage of arms and associated terminology. Given sufficient time, the practical definition of what constitutes a small arm or light weapon is likely to shift, and new technologies (or refined iterations of existing ones) may affect how SALW are best classified.

ARCS only seeks to classify arms which are designed primarily to deliver lethal effects. Many weapons that are designed primarily to deliver lethal effects are also capable of delivering less-lethal effects when used with the appropriate ammunition.⁹ Air weapons, although sometimes capable of wounding and killing human beings, are excluded due to their uncommon use in conflicts or serious crime and their typical lack of lethality (see *Air Weapons*, p. 105).¹⁰ Whilst only lethal-purpose arms are classified under ARCS, ARCS does classify both less-than-lethal and non-lethal munitions, including riot control agents (RCA), pyrotechnics, sensors, and other ‘support munitions’. As noted, lethal-purpose weapons are often capable of firing less-lethal or non-lethal munitions (this is particularly true for light weapons and heavy weapons). It should be noted that ARCS does not attempt to classify pre-gunpowder weapons, including edged and blunt-force *mêlée* weapons and primitive projectile weapons, such as bows or crossbows (sometimes referred to collectively or in part as *armes blanches*—‘cold weapons’ or ‘white arms’). Although, historically, these types of weapons have sometimes been referred to as ‘small arms’, within ARCS that term is only applied to firearms (see *Firearms & Guns*, p. 34).

Modified & Converted Firearms

When a user modifies an arm or munition in a way that significantly changes its functional characteristics, it may be classified differently than it would have been in its original form. An automatic rifle re-chambered for a handgun cartridge, for

⁹ For example, shotguns are commonly used for less-lethal purposes by law enforcement agencies (Coppola, 2018; UNDPKO, 2015).

¹⁰ Air rifles and pistols are primarily dependent upon air or gas pressure (and therefore projectile velocity) for their lethal effect, and can quite easily be manufactured (or modified) to be as lethal as a .22 LR rifle—although designs capable of firing multiple shots at these high pressures are rare.

example, would be classified as a sub-machine gun. This approach can mean that an item not ordinarily captured by ARCS—such as a blank-firing device, for example—could be given an ARCS classification if converted in a meaningful way (e.g., to be capable of firing lethal-purpose ammunition). Cosmetic or ergonomic modifications will generally not result in a change in classification.

Improvised & Craft-produced Weapons

Any system of classification is also inevitably limited in terms of improvised and craft-produced arms and munitions, due to their inherently non-standard nature. Nonetheless, ARCS is designed such that any contemporary munition or lethal arm can be classified to a greater or lesser extent. Arms and munitions produced outside a traditional commercial manufacturing enterprise can almost always still be classified using ARCS—they may, however, require a technical specialist to examine them, depending on their complexity. This includes weapons produced via both traditional craft-production techniques (so-called ‘workshop guns’), as well as those produced via emergent techniques (such as 3D-printing or electrochemical machining).¹¹ Classification will be relatively straightforward for some weapons. A ‘Luty’-style sub-machine gun is, generally, recognisably of that pattern, and will most often have all of the attributes necessary for classification as a sub-machine gun. By contrast, a concealed, single-barrel smoothbore weapon firing shotgun cartridges may defy easy classification at first glance. Even the latter would fit the ARCS schema, however, being best classified under the ‘manually operated shotguns’ Sub-type. Such items will often be much harder to *identify*, however, due to a lack of markings or identifiable features.¹² Homemade munitions are often considered improvised explosive devices (IEDs), particularly in a military and law enforcement context. Nonetheless, many of these—especially where produced with uniformity by some non-state actors—can already be classified under developmental versions of ARCS.

Methodology

ARES has developed a wide range of definitions and classification methods incrementally over a period of nearly eight years. For the past three years, the authors have been actively refining previous developmental work to produce ARCS. It has been extensively tested and implemented internally and by various external clients of ARES. Definitions developed by ARES personnel or derived from ARES publications are already used by a range of NGOs, museums, academics, and professional researchers. For the first time, this public release of the refined system and its associated terminology is designed to provide a single point of reference for

11 ARES produces a monthly report examining 3D-printed firearms. See: <<https://armamentresearch.com/briefings/>> For more details on traditionally craft-produced firearms, see: Jenzen-Jones & Hays, 2016; Hays & Jenzen-Jones, 2018; Jenzen-Jones & Ferguson, 2018b. For further information on emergent SALW production technologies, see: Hays, T. & Jenzen-Jones, 2020.

12 Nonetheless, detailed macro- or micro-analysis of the physical characteristics and markings of improvised or craft-produced arms and munitions can sometimes permit identification of a specific maker or country of origin (Hays & Jenzen-Jones, 2018; Jenzen-Jones & Ferguson, 2018). ARES is continuing to develop a typology for analysis of craft-produced SALW.

the quick and accurate classification and definition of SALW. It builds upon work by ARES personnel contained in various internal and external documents, published from 2014 to the time of writing.¹³

The definitions presented within ARCS were arrived at through a collaborative process involving contributing authors for a given section, as well drawing on previous work from other contributors, which proceeded as follows:

- 1. An extensive review was conducted of the English language literature in order to identify as many extant definitions and terms as possible (Ferguson, 2015a; 2019). Non-English sources were also consulted, with a particular focus on French, German, Russian, and Chinese sources. These assessments were made in collaboration with arms specialists who are native speakers of these languages.¹⁴**
- 2. Each author compiled an independent personal 'first look' list of definitions based upon his own experience and opinions. This was intended to permit a natural variety in approach that would then be mediated by the group.**
- 3. Exchanging these initial series of definitions, the authors worked collaboratively through each definition, discussing at great length the technical and practical merits of each proposal. When a consensus was reached, a working definition was agreed upon for each term.**
- 4. This initial agreement was then refined to create a working draft and circulated for comment, passing through more than thirty iterations.**
- 5. Finally, these draft definitions were peer-reviewed by further specialists in the field and a final draft produced by the primary authors. More than twenty subject-matter specialists were consulted during the drafting phases, and many more reviewed the preliminary ARCS (versions 1.1 & 1.2) documents.**

The approach followed by the authors has been to produce definitions which are clear and simple wherever possible, preferring to acknowledge any complexities beyond the necessary in explanatory notes. The resulting definitions are short, omitting any detail that might semantically rule in or out weapons otherwise regarded as fitting the description. They have been exhaustively tested against a range of examples to ensure fitness for purpose. The definitions are, wherever possible, derived solely or

13 Jenzen-Jones & Ferguson, 2014; Ferguson et al, 2015; ARES, 2017a; 2017b; 2018; Hays & Jenzen-Jones, 2018; Jenzen-Jones & Schroeder, 2018; Jenzen-Jones, 2019a; 2021. Note that other key ARES documents have been relied upon in developing the broader internal version of ARCS, which classifies Heavy Weapons and Munitions, in addition to Small Arms and Light Weapons.

14 Generally, the authors found the modern usage of the majority of terms and definitions in non-English languages to be in broad agreement with their English equivalents. Significant exceptions were noted, translated, and taken into consideration. These included the Russian use of 'automatic carbine' for 'assault rifle'; German use of 'machine pistol' for 'sub-machine gun'; and elements of the Chinese military system of designation (e.g., Automatic Infantry Small-arm (QBZ) for infantry rifles of different designs).

primarily from the observable technical characteristics of a weapon, rather than its perceived or actual role in contemporary conflict. Emphasis is also given to present-day rather than historic understandings of extant terms and definitions.

Wherever possible, these definitions have also been written with an eye toward future small arms trends and developments, in order to maximise their relevance over time. Nonetheless, it is the authors' firm belief that any useful definitions in this field should be revisited on a regular basis, being reassessed in light of technological developments and evolutions in technical and general language. Users and other stakeholders are encouraged to contribute via the ARES website.¹⁵

Using This Guide

ARCS is intended to contribute to consistency and clarity of reporting and communication between users and across user groups, keeping individuals and organisations on the same proverbial page in terms of nomenclature as well as classification. Military personnel will be familiar with their own service or national level systems of classification, but should find ARCS to be more universally applicable, eliminating the military tendency to classify arms and munitions based upon formally assigned roles. Law enforcement employees, forensic scientists/examiners, and those in other criminal justice roles should find that there is considerable advantage in a consistent, shared language that bridges sectors and national boundaries. Civilians operating in conflict zones as journalists, or with NGOs or government agencies, are less likely to have familiarity with any existing loose system and will find that they can 'pick up' and use ARCS quickly and effectively. Museum curators and other material culture specialists will find the universality of ARCS particularly helpful when dealing with arms and munitions that vary significantly in design and appearance, and which may span several centuries.¹⁶ Finally, academic researchers in various fields who choose to adopt the system will be able to more effectively engage with these other groups and with the specialist SALW literature.

This report provides readers with a working understanding of how arms and munitions can be classified, and furnishes definitions for the most common categories of arms and munitions encountered in the course of AMIs. Note that the identification of arms and munitions is not the focus of this guide. For a basic overview of the process of identifying SALW and their ammunition, see *An Introductory Guide to the Identification of Small Arms, Light Weapons, and Associated Ammunition* (Jenzen-Jones & Schroeder, 2018).

¹⁵ See: www.armamentresearch.com/ARCS

¹⁶ ARCS is designed, primarily, to classify contemporary arms. The term 'contemporary arms' is used in the sense established by *Armax: The Journal of Contemporary Arms*, to mean those arms and their ammunition developed or adopted after 1800 (Jenzen-Jones, 2021b).

Classification Levels

Arms and munitions may be classified and identified by examining an item in increasing detail. ARCS provides for the classification of arms and munitions at five levels: Class, Group, Type, Sub-type, and Method of Operation.¹⁷ Some researchers may have as their primary goal the classification of arms and ammunition: that is, determining the Class, Group, Type, or Sub-type of the item in question. Other research requires the precise identification of the item: that is, positively determining, at a minimum, the item's make and/or its model (see *Classification vs. Identification*, p. 21). At each level, more information is required about the physical and mechanical properties of the item in order to classify it. The amount and type of available information and the skill level of the researcher will determine the detail and accuracy of a classification or identification. Distinction at the Sub-type (Level 4) and Operating System (Level 5) levels are only made where deemed necessary to further classify arms or munitions on the basis of recognised differences. Further distinctions at these levels may be made in future. The five levels of ARCS classification are as follows:

Level 1: Class

At the most basic level, all arms and munitions covered by ARCS can be placed into one of four classes. Arms and munitions are divided at the Class level based upon macro-level physical characteristics such as portability, as well by their as broad function (i.e., arms vs. munitions):

- **Small Arms**
- **Light Weapons**
- **Heavy Weapons**
- **Munitions**

The first two Classes—'Small Arms' and 'Light Weapons'—are sometimes considered together due to their wider proliferation and combined use at the small unit (infantry squad or equivalent) level, which in turn is a function of their man-portability. Nonetheless, light weapons are often also held at higher organisational levels and are widely used in conjunction with vehicles. 'Heavy Weapons' are often more complex in both their construction and destructive potential; as such, their sub-division and classification is correspondingly more complex than for small arms or light weapons. 'Munitions'¹⁸—including ammunition for small arms, light weapons, and heavy weapons—are often classified by armed forces based on the domain from which they are employed: land, air/space, and sea/subsea. Distinctions at the class level are less useful for munitions than for arms, with the primary distinctions occurring at

¹⁷ Future versions are intended to provide guidance on how to define which domains (e.g., land, sea, air) are applicable to different arms and munitions, as well as how to distinguish between hand-held, crew-served, auxiliary, towed, and integrated weapons.

¹⁸ 'Munition' is used to mean "a complete device charged with explosives; propellants; pyrotechnics; initiating composition; or chemical, biological, radiological, or nuclear material for use in operations including demolitions" and includes all small arms and light weapons ammunition (U.S. DoD, 2020, p. 148). This is largely reflected in the International Ammunition Technical Guidelines (IATG) definition of ammunition (UNODA, 2015, Mod. 01.40, Para. 3.8).

the Group level. As such, munitions are placed in one Class, with domain identifiers indicating the domain(s) in which they are employed.

Level 2: Group

Within each Class, arms and munitions are separated into broad groups. Categorisation by Group is often possible through a simple visual examination of the item's major physical characteristics. Small arms, for example, are divided into two Groups: 'Long Guns' and 'Handguns'. For small arms, this macro-level physical distinction is usually very easy to determine, greatly simplifying the process of classification down to the Group level.

Levels 3 & 4: Type & Sub-type

The division of Groups into Types, and then Types into Sub-types, is based on the most significant functional or mechanical differences within the broader Groups. The complexities of these divisions vary by Group, but items are generally further refined with more mechanical or physical detail at the Sub-type level. For small arms, for example, a key distinction at the Type level for small arms is whether or not the weapon is rifled. Researchers may often (correctly) assume that a given weapon is rifled during this step, as most modern firearms feature rifling, and most unrifled ('smoothbore') firearms in circulation are distinctive.¹⁹ A similar logic is applied to other Classes. Some Types will not be broken into Sub-types, as further classification is not deemed necessary to separate out key categories of items.

Level 5: Method of Operation

Arms and munitions make use of a variety of operating systems and principles (often known as 'actions' when applied to firearms). There are varying degrees of overlap between mechanically similar designs within the Small Arms, Light Weapons, and Heavy Weapons Classes, as well as between Classes. Some light weapons may be scaled-up small arms, for example. Even a 105 mm artillery gun operates in a fashion fundamentally similar to small arms, most often either manually or partially recoil-operated (see *Small Arms Operating Systems*, p. 70). Arms employing the recoilless principle of operation likewise span the Light Weapons and Heavy Weapons categories, for example.²⁰ Munitions have their own methods of functioning that are sometimes used as a point of further distinction at this level.

19 Smoothbore (unrifled) firearms pre-date their rifled counterparts, and weapons designed to fire multiple projectiles from a single barrel (broadly analogous to modern shotguns) date back to the dawn of firearms technology (Jenzen-Jones & Ferguson, 2018a; Jenzen-Jones, 2021a).

20 Further introductory information on SALW operating systems may be found in the freely available handbook *An Introductory Guide to the Identification of Small Arms, Light Weapons, and Associated Ammunition*, published by the Small Arms Survey (Jenzen-Jones & Schroeder, 2018).

Classification vs. Identification

A given arm or munition is classified by using the item's observable physical characteristics to establish its place within the ARCS schema. This operation can typically be completed—with varying degrees of fidelity—even in the absence of visible manufacturer details, nomenclature, colour coding, or other markings. Identification, on the other hand, involves determining such specific information about the item, such as its make, model, and country of origin (where the item was designed, manufactured, and/or issued). Positive identification of an item often requires detailed information that may or may not be readily available to a researcher or analyst. The item's physical features may have been modified, its markings may have been deliberately removed, it could have sustained battlefield damage, or it may be encountered in an otherwise incomplete state.²¹ Because ARCS begins with more fundamental aspects of classification, it does not necessarily depend upon these details. It can, therefore, typically be used to classify an item not yet identified, providing the investigator with a solid foundation from which to attempt identification.²²

In some cases, even a positive identification may not necessarily provide an investigator with everything they need to classify an item. Likewise, having a subject matter expert classify an item may not reveal the make and/or model if there is insufficient information (e.g., when working from limited photographic evidence). The identification process does not necessarily proceed according to the hierarchy of classification. It is not always necessary to know a weapon's operating system, for example, to identify a weapon's manufacturer. In many cases, the fastest way to identify a weapon is by looking at distinctive features or markings, such as markings that denote the make and model (which are sometimes very clear).²³ Once the make and model are confirmed, characteristics which influence the weapon's classification are often easily identified. The identification process for a practitioner with access to the item in question—or detailed photographs—would focus on an assessment of an item's physical features and markings, and may proceed as follows:

21 Of course, some items may be found in pristine condition—such as in a shipping container, complete with user manuals—and in those cases the identification process may be greatly simplified.

22 For an introduction to identifying small arms, light weapons, and their ammunition, see Jenzen-Jones & Schroeder, 2018.

23 Of course, in other cases, such markings may be entirely spurious. For a basic primer on identifying small arms and light weapons, see Jenzen-Jones & Ferguson, 2018a; 2018b. For more specific information on craft-produced firearms (including 3D-printed firearms), see Hays & Jenzen-Jones, 2018; Hays, T. & Jenzen-Jones, 2020.

1. Determine Class.
2. Determine the make and model (and variant, if applicable) if possible.
3. Determine Type if make and model cannot be determined.
4. Determine Group if Type cannot be determined.
5. Continue to refine as necessary until the make and model are identified, or no further progress is possible.
6. (Optional) Conduct unique identification (UID) and/or gather further information as required.

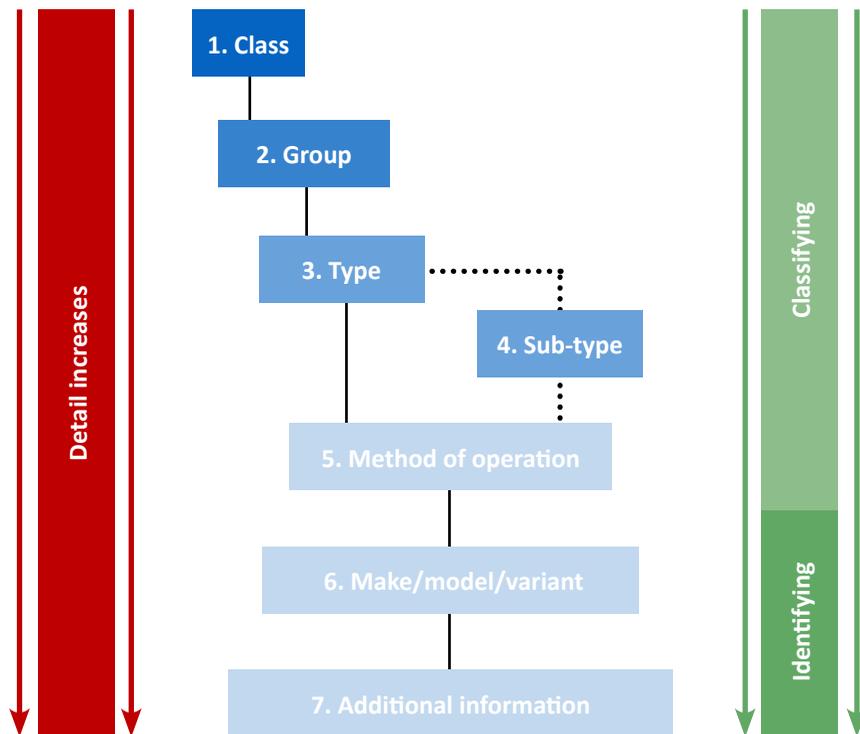


Figure 1.1 The levels of SALW classification as outlined in ARCS. From the top down, each level increases in detail (and, broadly, intensionality) and clarity, moving from the general classification task to that of identification (source: ARES via Jenzen-Jones & Schroeder, 2018b).



PART ONE



CLASSIFYING AND DEFINING SMALL ARMS & LIGHT WEAPONS

N.R. Jenzen-Jones & Jonathan Ferguson

Introduction

As noted, the first and most basic level of classification within ARCS is that of Class. Arms within the ‘Small Arms’ (see *Figure 2.3*) or ‘Light Weapons’ (*Figure 2.4*) Classes are typically portable (either by individuals or by crews; see below), and are frequently distributed at relatively low organisational levels in modern armed forces. Small arms are widely held and used by a range of military, law enforcement, civilian and other groups and individuals, and comprise the most numerous and widely distributed Class of weapons in ARCS. Light weapons are more often found in military service than in the hands of civilians or law enforcement, and are generally held at higher organisational levels and distributed on a more numerically limited basis.

Small arms are divided into two Groups: ‘Long Guns’ and ‘Handguns’. For small arms, this macro-level physical distinction is usually very easy to determine, greatly simplifying the process of classification down to the Group level. It is based on the part(s) of the weapon which are gripped by the firer’s hands. Either both hands are placed in a single location (or only one is typically used), making the small arm a handgun (see *Figure 2.1*), or the hands are placed in two different locations, making the weapon a long gun (see *Figure 2.2*). For light weapons, the Group distinction is between broad operating principles—primarily separating ‘Light Guns’ (e.g., heavy machine guns, cannon, grenade launchers, and mortars) from ‘Light Powered Mmunition Launchers’ (e.g., rocket launchers and missile launchers). Less common light weapons, such as flamethrowers, are grouped under an ‘Other Light Weapons’ category.

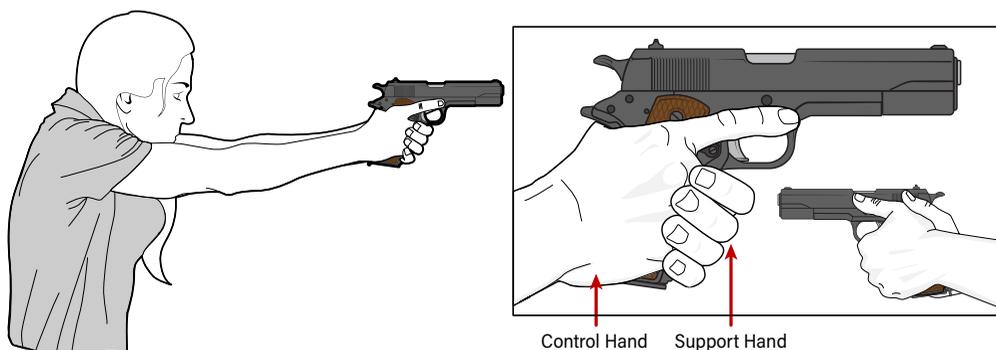


Figure 2.1 Typical gripping method used for a handgun.

At the Type level, a key distinction for small arms is whether or not the weapon is rifled. Researchers may often assume that a given weapon is rifled during this step, as most modern firearms feature rifling, and most unrifled (‘smoothbore’) firearms in circulation are distinctive.²⁴ Although smoothbore long guns (other than shotguns)

²⁴ Smoothbore (unrifled) firearms pre-date their rifled counterparts, and weapons designed to fire multiple projectiles from a single barrel (broadly analogous to modern shotguns) date back to the dawn of firearms technology (Jenzen-Jones & Ferguson, 2018a; Jenzen-Jones, 2021a).

and smoothbore handguns exist, they are relatively rare in the context of modern AMIs. Weapons are classified at the Sub-type level, where applicable, based on whether they use a self-loading or manually operated action. For Light Weapons, distinctions at the Type level are made on the basis of operating system and ammunition type, separating, for example, recoilless guns from grenade launchers, and heavy machine guns from light cannon. At the Sub-type level, only mortars are currently distinguished—being broken into ‘Light Mortars’ and ‘Medium Mortars’ to reflect both a common doctrinal distinction, and a key difference in terms of portability and crew size.

Level 5 (operating system) classification is currently available for the Small Arms Class (but not yet for Light Weapons), separating weapons that are otherwise visually and operationally similar by distinguishing the mechanical function of their actions. See *Small Arms Operating Systems*, p. 70, for further details.

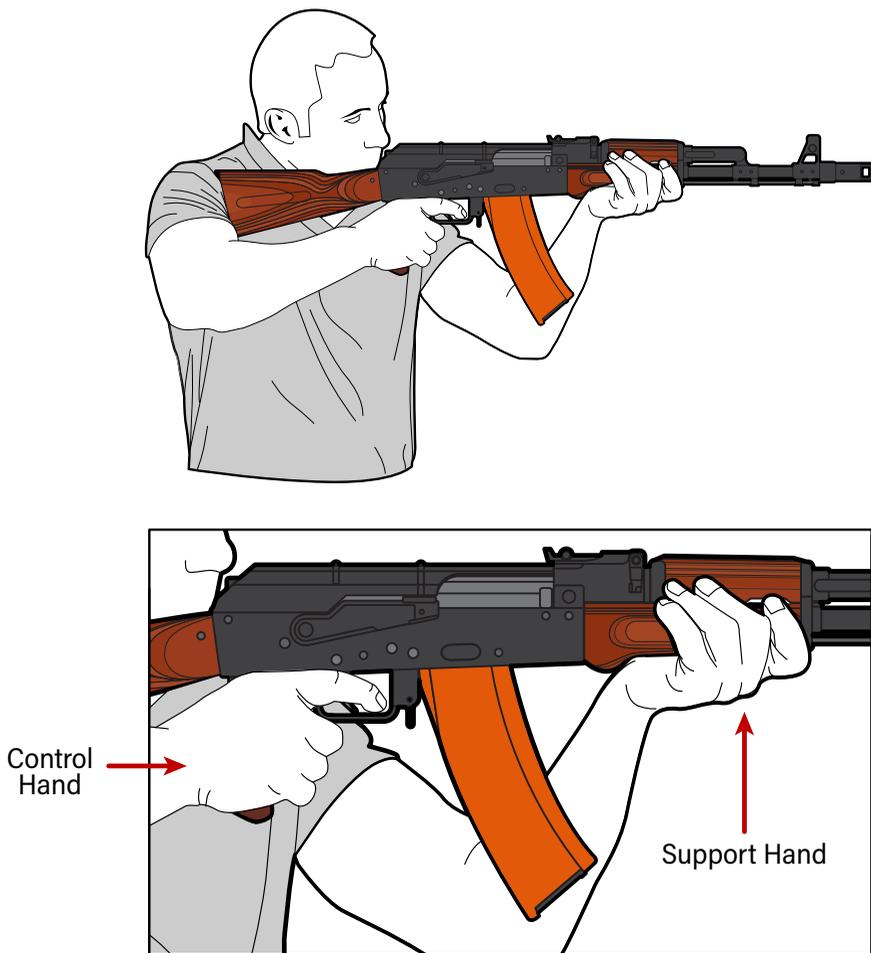


Figure 2.2 Typical gripping method used for a long rifle.

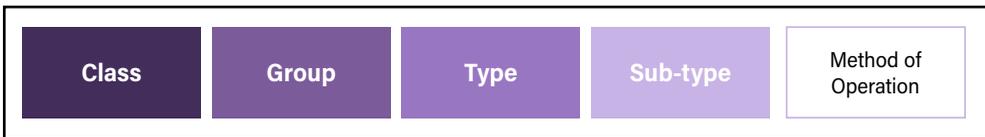
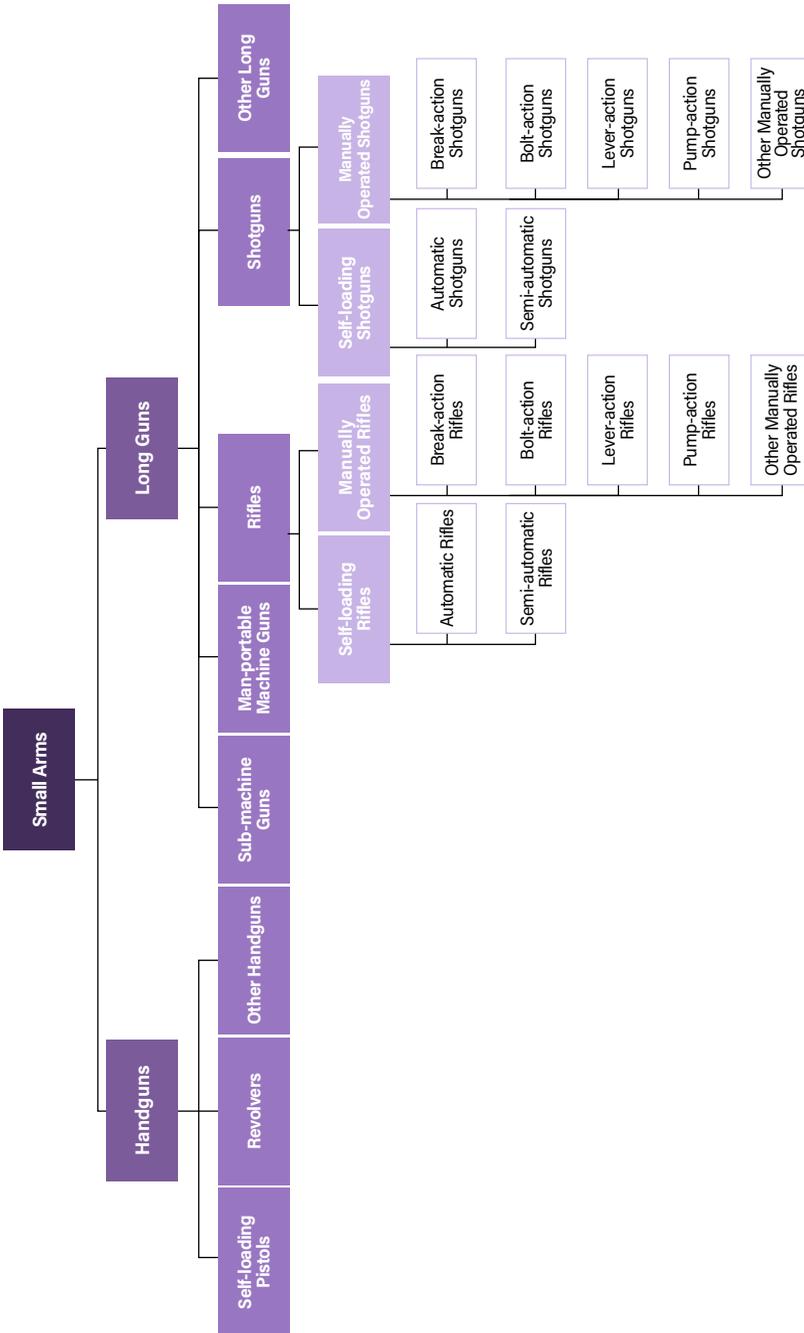


Figure 2.3 The ARCS classification schema for the Small Arms Class (source: ARES).

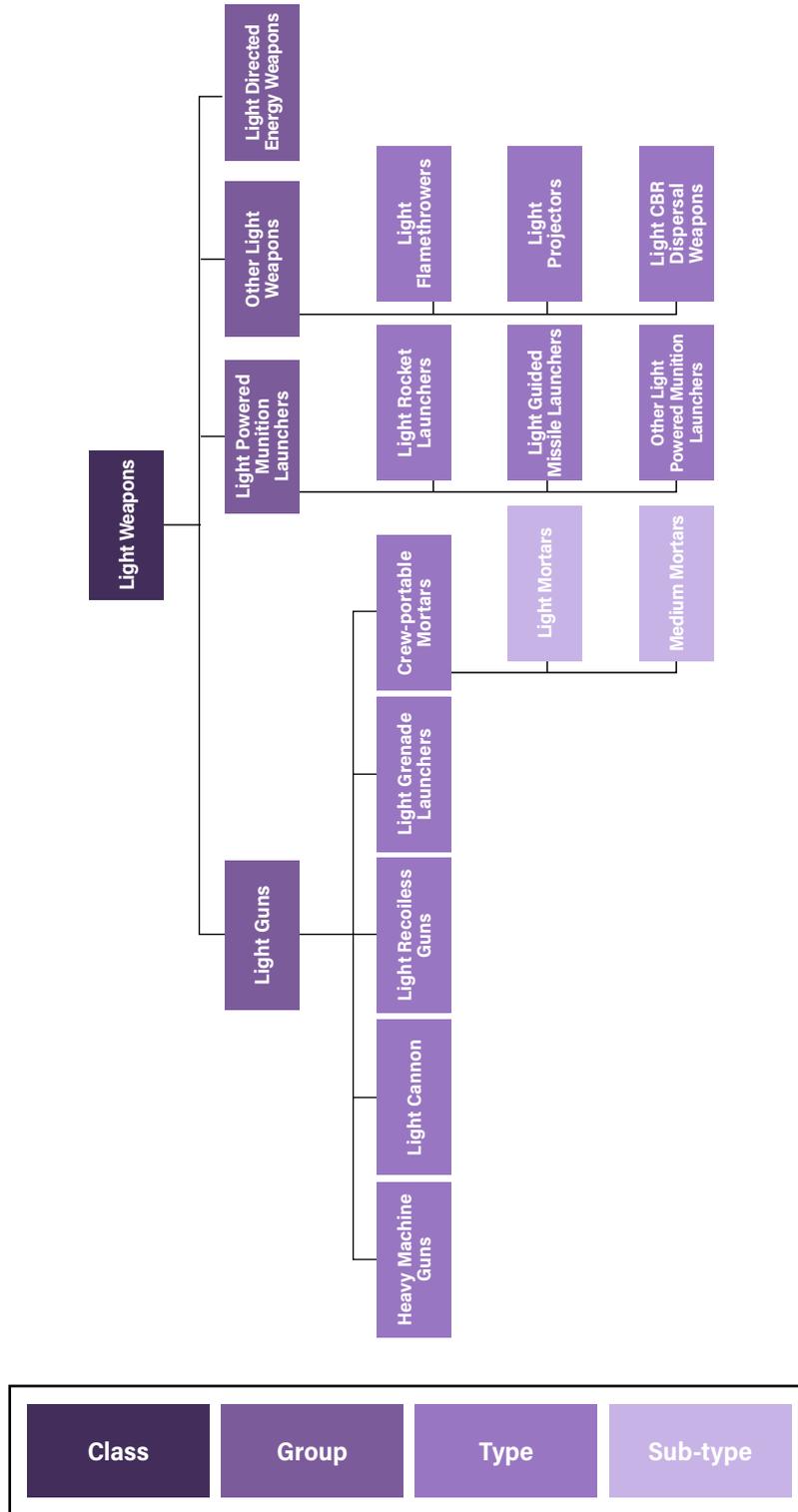


Figure 2.4 The ARCS classification schema for the Light Weapons Class (source: ARES).

Distinguishing Small Arms from Light Weapons

A key distinction to be made at the Class level is between ‘Small Arms’ and ‘Light Weapons’. One would be forgiven for thinking this issue must have been previously resolved in the literature, but in fact most extant definitions of SALW do not clearly distinguish between these two categories of weapons (Ferguson et al., 2015; ARES, 2017a). Defining precisely what constitutes a light weapon, in particular, can be problematic for a variety of reasons, and the term has often been overlooked—or considered redundant—by international actors. The *Weapons Law Encyclopedia* (Geneva Academy, 2017), for example, long contained a definition of ‘small arms’ but no definition for ‘light weapons’.²⁵ The Small Arms Survey even went so far as to title a 2011 chapter on light weapons in their flagship publication ‘Larger but Less Known’ (Herron, Marsh & Schroeder, 2011). Nonetheless, many existing international instruments and definition systems still draw a key distinction between these two categories, setting the line at what a single individual may carry and operate (UNGA, 2005b). An additional consideration is the shared mechanical similarity between some small arms and some light weapons. Because some light weapons are essentially scaled-up small arms, it can be difficult to distinguish the two categories without assessing portability (i.e., by means of a physical description alone). As such, assessing a weapon’s portability is a useful and appropriate method to distinguish small arms and light weapons, and is used as the foundational basis herein.²⁶ Taking portability as the most practical and fundamental distinction the two classes, it is relatively simple to draw a line between these based upon which weapons may be transported and effectively employed by a single individual on foot.²⁷ This is also likely to account, at least to some degree, for future weapons development, such as the advent of directed-energy weapons. However, existing understandings of the term ‘small arms’ often explicitly rule out more destructive man-portable weapons. The categorisation of small arms as consisting only of firearms is deeply entrenched in most existing understandings of the terms, and thus ARCS also makes a distinction between the two classes by destructive potential and calibre.

Distinction by Portability

Broadly speaking, most contemporary discussion of SALW agrees that both small arms and light weapons are portable, and that small arms are portable by a single individual, whilst light weapons typically (but not always) require multiple people to

25 See: <<http://www.weaponslaw.org/>>. The website was subsequently updated with a glossary entry for light weapons, but not a full ‘Weapons’ entry.

26 This boundary remains blurred in many cases, however. The International Small Arms Control Standards (ISACS) defines a light weapon as “...any man-portable lethal weapon designed for use by two or three persons serving as a crew (although some may be carried and used by a single person) that expels or launches, is designed to expel or launch, or may be readily converted to expel or launch a shot, bullet or projectile by the action of an explosive.” See UN CASA, 2018, p. 17.

27 The concepts of ‘portability’ and ‘crew-served’ weapons are unavoidably connected to role, but remain a primary distinguishing characteristic between small arms and light weapons.

transport (Jenzen-Jones & Ferguson, 2014; Ferguson, 2015a). Needless to say, carriage and operation by a crew implies a degree of portability of the component parts of a given weapon or weapon system. This distinction necessitates that ‘portability’ itself be defined. This is relatively straightforward for small arms, in which context a ‘man-portable’ weapon is simply one which can routinely be carried and used by a single individual. It is much harder to define in the case of light weapons. Some descriptions of light weapons indicate that they must be ‘man-packable’ by no more than three people when broken down into loads (e.g., gun and mount).²⁸ Notably, this approach features in the International Tracing Instrument (UNGA, 2005a).²⁹ However, this distinction would exclude a great many weapons often considered light weapons, including many of those listed in the ITI itself (such as ‘portable anti-aircraft guns’).³⁰

There is unlikely to be universal agreement as to what constitutes portability. Many of the light weapons listed in the ITI are most likely to be employed from light vehicles, for example, and would rarely be moved by a team of two or three individuals. 100 mm mortars, for example, are included in the ITI definition, whereas even the standard NATO 81 mm mortar requires a crew of four or five to carry and operate it (Department of the Army, 2007). In practice, a 60 mm mortar is the upper limit for a crew of three. Similarly, effective AA guns (i.e., automatic cannon of 20 mm or greater in calibre) and contemporary anti-tank guns are far too heavy to be considered portable—they are almost invariably mounted on, or towed behind, a vehicle. Some international organisations, such as the Small Arms Survey, refer back to the influential 1997 UN report, the *Report of the Panel of Governmental Experts on Small Arms* (PGE-SA), and consider light weapons as those which may be transported by “two or more people, a pack animal or a light vehicle”—significantly expanding the weapons which would be covered by the term ‘light weapons’ (Herron et al., 2011; Small Arms Survey, n.d.; UNGA, 1997). This, in turn, raises the rather thorny problem of how best to define a ‘light vehicle’. ARCS instead relies on the more fundamental human portability principle and restricts the category of Light Weapons to those that are either man-portable (i.e., can be transported and operated by a single individual on foot) or crew-portable (‘man-packable’³¹) by no more than five people on foot.³² This expansion, from the oft-cited two or three individuals to five, allows for weapons that are clearly intended to be captured under the light weapons category by many other systems. Light Weapons are further limited under ARCS to those weapons which weigh 300 kg or less when in firing configuration (not including

28 Ammunition is a significant consideration in terms of manageable weight, however the amount carried varies considerably by weapon, and is influenced by the doctrine of the force employing it.

29 Initiated by the United Nations ‘Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects’ (PoA). See UNGA, 2001b.

30 Most anti-aircraft guns which may be readily considered ‘portable’ by light vehicle are much too heavy and bulky to be transported by three or fewer people.

31 In most cases, the term ‘man-packable’ implies a crew-served weapon designed to be dismantled into parts, each of which can be carried by one person.

32 This assumes mechanically unaided individuals. Future developments of technologies such as assistive exosuits/exoskeletons are not considered herein.

ammunition weight). This represents the upper limit of what could be considered ‘crew-portable’.

When a small arm or light weapon is physically integrated into a vehicle’s structure, it is classified as a Heavy Weapon under ARCS. ‘Integrated’ means that the weapon is dependent on the vehicle to operate and cannot be removed without significant modifications. Integrating a small arm or light weapon into a vehicle is done for a variety of reasons, such as providing a more stable firing platform, increasing the quantity of ammunition immediately available, and enhancing mobility. When a small arm or light weapon is simply mounted on a vehicle—often by the use of a pintle- or cradle-style mount—it retains its original classification under ARCS. Such weapons have not been significantly modified, and can be quickly removed and used in a man-portable or crew-portable fashion if desired.



Figure 2.5 A five-man Russian mortar crew carrying a disassembled 2B24 Sani 82 mm medium mortar (source: CRI Burevestnik).



Figure 2.6 A Degtyaryov Plant PKTM machine gun, which is fired by a solenoid and typically integrated into armoured fighting vehicles (source: Rosoboronexport).

Distinction by Destructive Potential & Calibre

Existing understandings of the term ‘small arms’ often explicitly rule out more destructive man-portable weapons, and especially weapons delivering an explosive payload (e.g., auxiliary grenade launchers) (ARES, 2017a). As a result, ARCS restricts the Small Arms Class to firearms, whilst the Light Weapons Class comprises firearms and other types of weapons (see *Firearms & Guns*, p. 34). Firearms are divided between the Small Arms and Light Weapons classes on the basis of portability (see above) and calibre. Different organisations and authors have historically relied on different calibre cut-off points between small arms and light weapons (Ferguson, 2015a). Some classification systems instead draw the distinction in a more indirect manner, separating weapons firing ‘small-calibre’ cartridges from those firing ‘medium-calibre’ cartridges. Again, the cut-off point between small-calibre and medium-calibre ammunition varies. The smallest common calibre acknowledged as being ‘medium calibre’ is typically one of the following: 12.7 mm (i.e., half an inch), 14.5 mm, 15 mm, or 20 mm (Jenzen-Jones, 2019). The Wassenaar Arrangement, for example, uses calibre as a key metric in its Control Lists to separate weapons in categories ML.1 from those in ML.2; those in ML.2 include: “Smooth-bore weapons with a calibre of 20 mm or more, other weapons or armament with a calibre greater than 12.7 mm (calibre 0.50 inches)” (WA, 2015a). This is broadly comparable to the language in the EU Common Military List (EU, 2020). The Small Arms Survey has historically used 10,³³ 12.7, and 14.5 mm in various publications as the dividing point between small- and medium-calibre ammunition, but later moved toward accepting a “less than 20 mm” calibre limit for small-calibre ammunition (Bevan & Pézard, 2006, pp. 23; 26–29;³⁴ Berman & Leff, 2008, p. 10 *cf.* Jenzen-Jones, 2013; 2014; 2018).³⁵

The U.S. military uses 20 mm as the starting point for those cartridges considered to constitute medium-calibre ammunition. The U.S. Army’s Program Executive Office Ammunition (PEO AMMO) is responsible for life-cycle acquisition management of all conventional ammunition,³⁶ and consists of six subsidiary project management organisations responsible for different portions of the U.S. Army’s ammunition requirements (US Army, n.d.(a)). One of these, Project Manager Maneuver Ammunition Systems (PM MAS), provides all U.S. military direct-fire combat and training ammunition.³⁷ PM MAS assigns responsibility for small and medium calibre ammunition to different product managers (PdM), with 12.7 × 99 mm (.50 BMG)

33 This applied definitively to heavy machine guns, and “generally” to other firearms in the light weapons category: “We have defined heavy machine guns as fully automatic weapons that fire small-calibre cartridges exceeding 10 mm, but less than 20 mm, in calibre. (Indeed, with the exception of some pistols and revolvers, we generally define firearms in the light weapons category as those chambered for 10 mm calibre rounds and larger)” (Berman & Leff, 2008, p. 10).

34 Inexplicably, the Small Arms Survey at one point referred to 12.7 mm cartridges as “Large calibre cartridge-based ammunition” (Bevan and Pézard, 2006, p. 29).

35 Unfortunately, more recent reporting has confused the matter further, with reference made to the 14.5 mm dividing line in a 2021 publication (Schroeder & Shumska, 2021).

36 According to the PEO AMMO website, this includes “integrating budgets, acquisition strategies, R&D and life-cycle management across all ammunition families” (US Army, n.d.).

37 Excepting less-lethal ammunition (US Army, n.d.(b)).

assigned to PdM Small Caliber and 20 mm cartridges assigned to PdM Medium Caliber (US Army, n.d.(b)). This generally accords with the approach taken by key industry observers and defence analysts, including Jane's (see, for example: Cutshaw & Ness, 2002; Ness & Williams, 2008; 2015) and Brassey's (Goad & Halsey, 1982; Courtney-Green, 1991).

Most major manufacturers of both 12.7 mm and 20 mm cartridges also consider the former to be small calibre, and the latter medium calibre. For example, Denel PMP of South Africa lists 12.7 × 99 mm cartridges as small calibre, and various 20 mm cartridges as medium calibre (Denel, n.d.(a); n.d.(b)). Similarly, Orbital ATK (United States) organises 12.7 × 99 mm cartridges under their Defense Systems – Small Caliber Systems business division, whilst 20 mm ammunition such as the 20 × 102 mm cartridge fall under the Defense Systems – Armament Systems division (ATK, 2016). General Dynamics Ordnance and Tactical Systems – Canada (GD-OTS Canada) also classifies 12.7 × 99 mm cartridges as 'small calibre' and 20 mm cartridges as 'medium calibre' (G-DOTS Canada, 2016). The UK's BAE Systems includes 20 mm calibres they produce under their 'medium calibre' product family (BAE Systems, 2021). For some manufacturers, these distinctions have changed over time. Nammo AS of Norway placed 12.7 × 99 mm cartridges under the 'Medium Calibre Ammunition' heading up until the 3rd edition of their *Nammo Ammunition Handbook* (2015), but more recently these cartridges have been listed under the 'Small Calibre Ammunition' heading, as seen in their 4th (2016), 5th (2018), and 6th (2021) editions. In later editions, the "Medium Caliber Ammunition" section of the handbook commences with 20 × 102 mm cartridges (Nammo, 2014; 2015; 2016; 2018; 2021).

Small arm [Class]

A **firearm** of less than 20 mm in **calibre**.³⁸

Light weapon [Class]

A weapon or **weapon system** which may be transported (with its **ammunition**³⁹ and any critical components⁴⁰) and operated by a **crew** of no more than five individuals on foot, weighs 300 kg or less (excluding ammunition) in a firing configuration, and does not meet the definition of a **small arm**.

38 Note that non-firearm small arms do exist, such as airguns and the unique 'Gyrojet' range of weapons (and other similar developments) that fire miniaturised rockets. However, alternatives to firearms within the Small Arms category are incredibly rare at the time of writing. In future, it is feasible that directed-energy weapons or mass-drivers may be miniaturised sufficiently to be classified as small arms. See *Directed-energy Weapons*, p. 108.

39 Whilst there is no readily-accepted understanding of how much ammunition must be carried, it is understood that even a light combat load for some weapons will constitute a substantial burden in terms of volume and weight. At a minimum, this figure should include a full weapon load of ammunition (e.g., an entire magazine, complement of rockets) and, in the case of reloadable weapons, one full reload of the same number of munitions. In many cases, significantly more ammunition will be carried.

40 Those required for the weapon to function.

Cartridges of 20 mm or greater in calibre often feature a high explosive payload (and, accordingly, the requisite fuzing), whilst those under 20 mm in calibre are most commonly produced with an inert (ball, armour-piercing, etc.) or pyrotechnic (incendiary, tracer, etc.) composition.⁴¹ Irrespective of payload, manufacturing techniques for 12.7 × 99 mm, 12.7 × 108 mm, and 14.5 × 114 mm cartridges, for example, share more in common with those of smaller calibres than those of calibres such as 20 × 42B mm, 20 × 82 mm, or 20 × 102 mm.

The calibre limit of 20 mm is a useful distinction for the vast majority of modern firearms. It includes, for example, common 12.7 mm rifle cartridges, as well as 12-gauge (18.5 mm) and 10-gauge (19.7 mm) shotgun calibres. Indeed, perhaps the most significant oversight of classification regimes using a 12.7 mm or 14.5 mm cut-off is the exclusion of shotgun cartridges—particularly the globally ubiquitous 12-gauge cartridge. There are some historical examples of rifles and shotguns chambered for calibres larger than 20 mm, which could properly be considered small arms rather than light weapons. These include large-bore rifles used to hunt dangerous game, particularly in the late 19th century, such as 4 bore (26.7 mm) and even 2 bore (33.7 mm) designs (Brander, 1988). All are very rare today.⁴²



Figure 2.7 Three common 20 mm cartridges compared with a common .50 inch (12.7 mm) cartridge. The former are used in light cannon, whilst the latter is used in heavy machine guns and some large rifles. Left to right: 12.7 × 99 mm, 20 × 102 mm, 20 × 128 mm, 20 × 139 mm (source: Nammo).

41 There are several exceptions to this general rule. Nammo's 12.7 × 99 mm MP cartridge and the Soviet 14.5 × 114 mm BZT cartridge, for example, both contain high explosive incendiary (HEI) compositions. It also bears mentioning that there has been a trend towards kinetic energy projectiles for use in 20 mm cartridges, such as Rheinmetall of Germany's Frangible Armour Piercing (FAP) projectiles (Kerk, 2014).

42 Whilst largely obsolete, limited numbers of modern firearms that would likely be considered small arms have been produced in these calibres. See, for example: Schroeder & Hetzendorfer, n.d; TOZ, 2004.

Given current and historical manufacturing and use trends, and the categories of weapons with which these calibres are used, ARCS uses 20 mm calibres as the dividing line between small- and medium-calibre ammunition, and hence between firearms falling into the Small Arms and Light Weapons Classes.

Firearms & Guns

The word ‘firearm’ originated in the mediaeval period, then referring to any weapon making use of fire for destructive effect. This included a range of weapons that would be considered incendiary weapons today, as well as those using combustible materials to propel projectiles. Though it became, and remains for most English speakers, synonymous with ‘gun’, a ‘firearm’ today can more properly be considered to be a man-portable gun (ARES, 2017a; Jenzen-Jones, 2021). The term ‘gun’ can be meaningfully applied to any weapon which uses the combustion of a propellant to generate high-pressure gas in a sealed chamber in order to accelerate a projectile in a controlled manner. This can include much larger weapons, such as artillery guns. Firearms must be able to be carried and employed by a single individual on foot. Thus, firearms are defined by the fundamental principle by which they propel projectiles (by the combustion of a chemical propellant within a sealed chamber—i.e., they are guns) *and* by their man-portability (they may be carried and employed by a single individual on foot). When most people use the word ‘gun’, they are thinking of small arms. Similarly, the term ‘firearms’ is sometimes used synonymously with ‘small arms’.⁴³

Firearm

A man-portable gun.

Gun

A weapon which uses the combustion of a propellant to generate high-pressure gas in a sealed chamber in order to accelerate a projectile in a controlled manner.⁴⁴

43 Nonetheless, many sources would still consider some larger guns—those which are not man portable, but which closely share mechanical operating principles and ammunition characteristics with small arms, such as heavy machine guns—to be firearms.

44 This excludes several ‘derived’ designs of gun that either use compressed gas that is not generated via chemical combustion, or accelerate a projectile by other means such as electromagnetic force (e.g., railgun, coilgun). None of these are seen in common use today.

Defining Small Arms & Light Weapons

Once a weapon has been classified as either a small arm or light weapon, it can be further categorised by Group, Type, and, in some cases, Sub-type. Within each of the Type and Sub-type categories defined below, examples are given of specific weapons (by make and model) which would fall into these classifications under ARCS. These are, of course, non-exhaustive and are meant only to provide a provisional and generic classification. Specific variants and/or chamberings, for example, will not necessarily be captured at this level of detail. If sufficient information is available, the weapon's method of operation may also be identified and categorised, providing the maximum amount of descriptive information about that weapon under ARCS.⁴⁵ When applicable, the combination of Type or Sub-type and Operating System information can provide a useful and objective two-part descriptor for a weapon (e.g., a rifle using a bolt-action system of operation may be usefully described as a 'bolt-action rifle').

Throughout this section, terms which are defined in the *Glossary* are rendered in **bold blue** text in the body of the report and underlined bold white text within definition boxes. Such terms are only identified the first time they are used in a definition or section.

Defining Small Arms

N.R. Jenzen-Jones & Jonathan Ferguson

Small Arms [Class]

Small Arm

A **firearm** of less than 20 mm in **calibre**.⁴⁶

The term 'small arms' has been used for centuries to include the range of personal **armaments** typically and traditionally carried by the individual foot soldier, including edged and staff weapons. In a 20th- and 21st-century context, however, the term 'small arms' refers exclusively to **firearms**.⁴⁷ Military, paramilitary, law enforcement, and civilian users the world over all make extensive use of firearms. The Small Arms Class is broken down at the Group level into **handguns** and **long guns**.⁴⁸ Small arms

⁴⁵ This is true even where such a Level 5 categorisation is not facilitated by ARCS (i.e., even where knowledge of a weapon's operating system is not necessary to classify it under ARCS, such information may still be descriptively useful).

⁴⁶ See fn 40.

⁴⁷ Bayonets being seen as an accessory for firearms, and combat knives no longer being regarded as 'small arms'.

⁴⁸ There are a small number of uncommon small arms designs which may be difficult to classify, generally representing

are all **chambered** for **small-calibre cartridges**.⁴⁹ Hand-held weapons which are not firearms, such as the **light rocket launcher**, are ruled out of this class both by customary definitions and, practically speaking, by their operating principles. Whilst both may be intended to be carried and operated by a single person, **man-portable** weapons other than firearms are classified as **light weapons** under ARCS. In future, the Small Arms Class may expand to include **directed-energy weapons**, **railguns** and **coilguns**, or other emergent technologies.⁵⁰

Handguns [Group]

Handgun

A **firearm** which is grasped by placing both the **control hand** and **support hand** around the **pistol grip**, and which may be readily fired with one hand.

The handgun, also called the 'pistol',⁵¹ is a **firearm** designed primarily to be light and very compact, so that it may be carried anywhere and at all times. Historically a one-handed weapon, this remains a design consideration despite modern users strongly favouring two-handed use. When used from unsupported positions (e.g., standing, kneeling, prone) handguns are most often grasped by placing both hands around the **pistol grip** of the weapon. Whilst not a prerequisite, handgun **barrels** are almost always **rifled** to enhance accuracy.⁵² In a military context, handguns typically serve as secondary weapons for users carrying **long guns** or other weapons. In law enforcement and civilian usage, they may be the sole or primary weapons for individual self-protection. They are also used in a range of sports shooting disciplines. Handguns are usually chambered for **handgun cartridges**, smaller and less-powerful than the **rifle cartridges** used for most long guns, and typically—although not universally—generating no more than 800 J of **muzzle energy** (Jenzen-Jones, 2018).⁵³ Some handguns may be fitted with a detachable or collapsible/folding **buttstock**, but

niche vocational requirements (e.g., humane killing devices, powerheads). A nominal 'Other Small Arms' category may be considered to exist.

49 That is, ammunition of less than 20 mm in calibre. Note that some light weapons (e.g., heavy machine guns) and heavy weapons are also chambered for small-calibre ammunition.

50 This would necessitate a definitional change, most likely directly affecting the term 'small arm', rather than adjusting the meaning of the underlying term 'firearm'.

51 The modern term 'handgun' came into use in the early 20th century as an umbrella term for non-repeating pistols, self-loading pistols, and 'revolving pistols' (as revolvers were known in the 19th century) (Jenzen-Jones, 2021). The term 'handgun' is generally preferred to 'pistol', to avoid confusion and provide symmetry with 'long gun'.

52 Most smoothbore handguns are less-lethal in purpose, however smoothbore lethal-purpose pistols may be encountered, including those designed solely to fire shot (sometimes called 'shot-pistols'), and craft-produced or converted handguns (where rifling is beyond the means or intent of the maker; see Florquin & King, 2018; Hays & Jenzen-Jones, 2018; Jenzen-Jones & Ferguson, 2018b; Hays, T. & Jenzen-Jones, 2020). A related device is the dedicated flare or signal pistol (see **SALW-adjacent Items not Classified by ARCS**, p. 101).

53 Sometimes, 'handgun' cartridges are fired from long guns (such as sub-machine guns and so-called 'pistol-calibre carbines') (Jenzen-Jones, 2021a). Note that, conversely, some handguns may fire rifle cartridges or shotgun cartridges, but these designs are rare.

this is rare. In addition to [self-loading pistols](#) and [revolvers](#), discussed below, less common designs of handgun may also be encountered. These include [break-open](#) designs such as [derringers](#); fixed or revolving ‘[pepperbox](#)’ designs with multiple barrels, each with its own chamber; and even [bolt-action](#) or [lever-action](#) models.

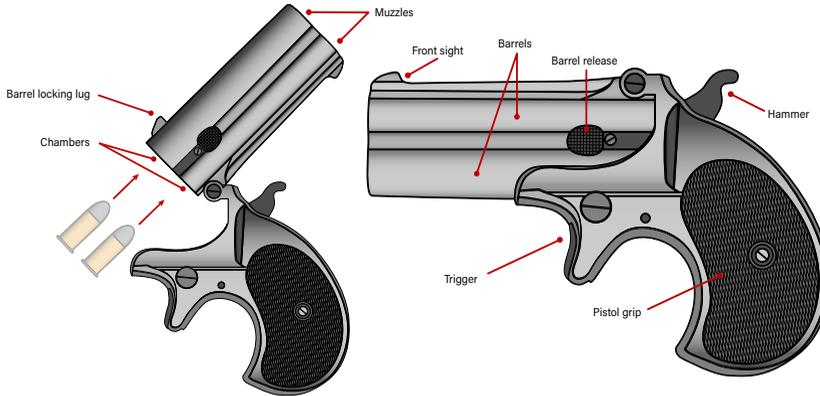


Figure 2.8 Typical parts of a break-open handgun, in this case a double-barreled derringer (sources: ARES).

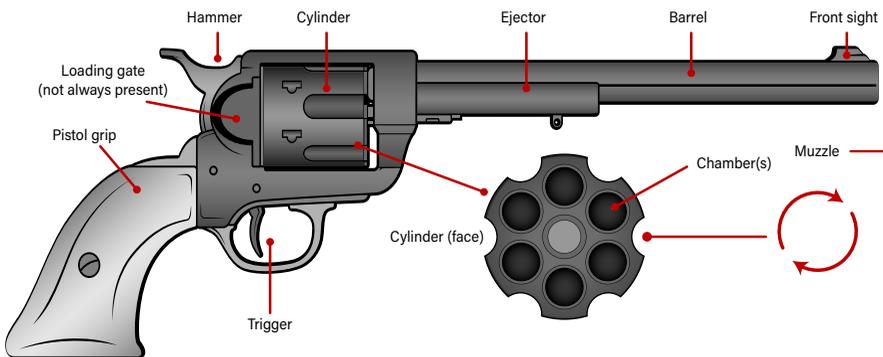


Figure 2.9 Typical parts of a revolver, in this case a single-action model (sources: ARES).

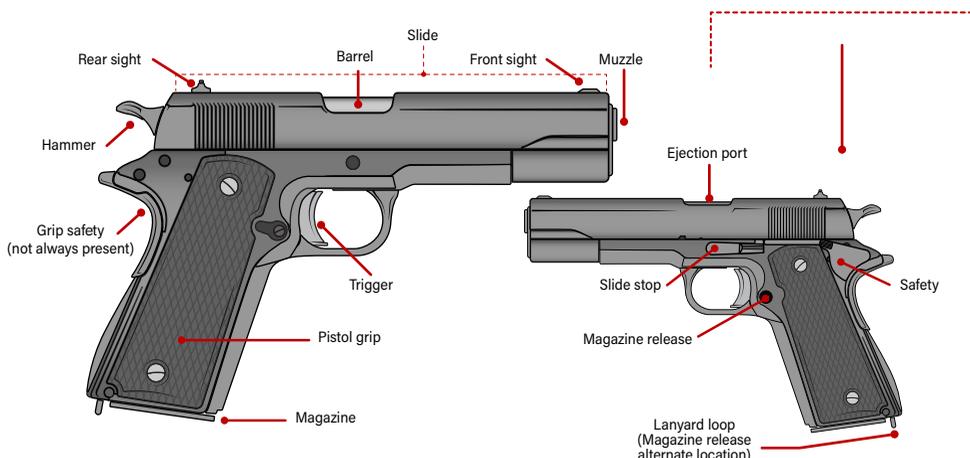


Figure 2.10 Typical parts of a self-loading pistol (sources: ARES).

Revolvers [Type]

Revolver

A **manually operated handgun** with a fixed **barrel** and a rotating **cylinder** containing multiple parallel **chambers**.

Modern revolvers are typically **double-action** designs, in which the **trigger** both **cocks** the weapon and releases the **hammer**, firing one shot per trigger pull. Traditionally, double-action revolvers could also be manually cocked for more deliberate, aimed fire. Some revolvers (often intended for defensive concealed carry) are of '**double-action-only**' (DAO) design; that is, their concealed or bobbed hammer can be cocked only through the pull of the trigger.⁵⁴ Some revolvers remain **single-action**—in which the trigger only performs the action of dropping the hammer. These require manual operation of the hammer between shots.⁵⁵ In all cases, the key features of the revolver are a fixed **barrel** with an arrangement of multiple **chambers** revolving behind it (a '**cylinder**'). Revolvers may also have multiple barrels, although this is rare. Although still in limited military and law enforcement service, revolvers are now most commonly encountered in civilian use.⁵⁶



54 This neologism mirrors (and replaces) the archaic term 'self-cocking,' applied to early revolvers without a hammer spur for manual cocking (notably the Adams of 1851; see: Scurfield, 1957).

55 Note that the original meaning of these terms was quite different, referring to the 'action' of the shooter's thumb and trigger finger in terms of cocking the weapon, and not to 'action' in the sense of a firearm's mechanism. Historically, 'single-action' denoted revolvers that were cocked by the 'action' of either the shooter's thumb or of their trigger finger (known as 'self-cocking'). 'Double-action' denoted models permitting both 'actions' (therefore also being 'self-cocking'). Due to the success of the Colt (single-action, thumb-cocking) and Beaumont Adams (double-action, self-cocking) revolvers, examples capable only of 'self-cocking' became uncommon. This resulted in thumb-cocking and trigger-cocking mechanisms becoming known as simply 'single-action' and 'double-action' respectively, and later hammerless and internal hammer revolvers (formerly 'single-action, self-cocking') being dubbed 'double-action-only' (DAO). To differentiate, the term 'double-action/single-action' (DA/SA) also arose (Scurfield, 1957; Ferguson, 2015a).

56 Even in the civilian context, revolvers remain significantly less common than self-loading pistols in most parts of the world (ARES, n.d.).



Figure 2.12 (Opposite page, left to right) Galand M1870 (.45 cal), S&W Model 360 (.357 Magnum/.38 Special). **(This page, top to bottom)** Webley Mk VI (.455 Webley), Chiappa Rhino (.357 Magnum/.38 Special), MAS Modèle 1873 (11 x 17.8R mm), Taurus Raging Hunter (.357 Magnum/.38 Special) [not to scale] (sources: Justin Baird/ARES, N.R. Jenzen-Jones/ARES; Wikimedia Commons; Taurus Armas S.A.; Chiappa Firearms).

Self-loading Pistols *[Type]*

Self-loading pistol

A handgun which makes use of the **chemical energy** stored in a **cartridge** to cycle the weapon's **action**, **extracting** and **ejecting** the **cartridge case** immediately after firing, and **chambering** a new cartridge from the weapon's **magazine**.

The fundamental characteristic of a self-loading pistol is its use of the energy generated by firing a **cartridge** to eject a fired ('empty') **cartridge case** and load a new one from a **magazine**. This operation can be performed by a wide variety of mechanisms (see *Small Arms Operating Systems*, p. 70). Self-loading pistols firing relatively low-powered **ammunition** typically utilise a simple **blowback** action, but more powerful ammunition generally necessitates a locked-**breech** mechanism, which is typically operated by **recoil**—although some examples are **gas-operated** or use some form of **retarded blowback** (see *Self-loading Firearms*, p. 74) in which the **operating system** slows the opening of the breech to allow pressure to drop to a safe level. **Trigger mechanisms** include **single-action**, **double-action**, and **double-action-only**, as well as hybrid mechanisms which are partially cocked by the energy of firing and partially by a manual pull of the trigger. Self-loading pistols will always be designed to **feed** from a magazine of cartridges to fire in sequence and this is normally, but not necessarily, detachable from the weapon.

Self-loading pistols are the dominant class of **handgun** today, in widespread global use by armed forces and law enforcement and, in many countries, owned by civilians. They are also known as 'semi-automatic pistols'. Less correctly, they are sometimes called 'automatic pistols', despite the fact that only a small minority are capable of **automatic** fire. These truly automatic self-loading pistols, sometimes known as 'machine pistols', are a subset of self-loading pistols (see *Automatic Firearms*, p. 76).⁵⁷ Some manufacturers, such as Glock and Beretta, have produced both **semi-automatic-only** and **selective-fire** variants of self-loading pistol models that are otherwise substantively the same. In many countries, the (typically illicit) conversion of semi-automatic pistols to automatic capability is popular.⁵⁸

57 See also the definition of 'sub-machine gun'. Although they are not always easy to categorise, some variants of SMGs designed or redesigned to be compact and stockless could be considered automatic pistols.

58 See, for example: Pérez, Ferguson & Jenzen-Jones, 2020.



Figure 2.13 Left column, top to bottom: Glock 17 (9 × 19 mm); Tula Arms Plant PM (9 × 18 mm); Heckler & Koch USP (.45 ACP); AMT Backup (.380 ACP). Right column, top to bottom: DWM Luger P08 (9 × 19 mm); Steyr Model 1911 (Chilean contract, 9 × 23 mm); Adler Pistole Modell 1906 (7.25 × 17.5 mm); Mauser Model 1930 (Chinese commercial contract, 7.63 × 25 mm) [not to scale] (source: Wikimedia Commons; N.R. Jenzen-Jones/ARES; Rock Island Auction Company).

Small Arms Ammunition

N.R. Jenzen-Jones

A variety of terms are used to describe ammunition used with small arms.⁵⁹ The vast majority of modern small arms are designed to fire cartridge-based ammunition. A cartridge is a self-contained unit of ammunition designed to provide fast and convenient way to reload a firearm, as well as providing good storage characteristics and resistance to environmental conditions. The modern cartridge case is also largely responsible for the rearward obturation which occurs upon firing a round, as the cartridge case wall expands under gas pressure to form an airtight seal against the chamber behind the projectile, resulting in the reliable and safe functioning of the firearm” (Jenzen-Jones, 2016). Modern small-calibre cartridges consist of the following major components:

1. **One or more projectiles** which are fired from the gun toward the target;
2. **Propellant**, which, when ignited by a primer, generates the gas pressure that propels the projectile out of the barrel;
3. **A primer**, which most often consists of chemicals designed to be initiated by a firing pin, hammer, or striker in the weapon. The primer, in turn, ignites the propellant;
4. **A cartridge case**, which contains the components of a complete round of ammunition and, when the weapon is fired, blocks the escape of gases in a way that causes pressure to build up behind the projectile (Jenzen-Jones, 2019).⁶⁰

Ammunition

Munitions which are fired by a weapon or weapon system. A single unit is a 'round'. Colloquial shortened form: 'ammo'.

Cartridge

A single, self-contained unit of ammunition consisting of a cartridge case, primer, propellant, and one or more projectiles. In caseless cartridges, the cartridge case may be absent, the cartridge's propellant fulfilling some of the same functions.

59 Definitions in this section are adapted from Jenzen-Jones, 2019.

60 This does not apply to caseless or semi-caseless cartridges, which are rare (Jenzen-Jones, 2016; Jenzen-Jones & Fitch, 2019).

Modern ammunition is of ‘centrefire’ or ‘rimfire’ type, terms that describe the location of the primer cap (derived from ‘percussion cap’, and typically referred to simply as a ‘primer’) or priming compound within the cartridge (Jenzen-Jones, 2019). The vast majority of modern ammunition is of the centrefire type, with a primer cap located centrally in the base of the cartridge. Both types are typically formed from brass, although steel is also common and polymers⁶¹ are increasingly in use (Jenzen-Jones, 2018; 2019).⁶² The cartridges primarily used with small arms (i.e., those under 20 mm in calibre) are classified as ‘small-calibre cartridges’ under ARCS. Cartridges from 20 mm to less than 57 mm in calibre are classified as ‘medium-calibre cartridges’, and those of 57 mm calibre or greater are classified as ‘large-calibre cartridges’.

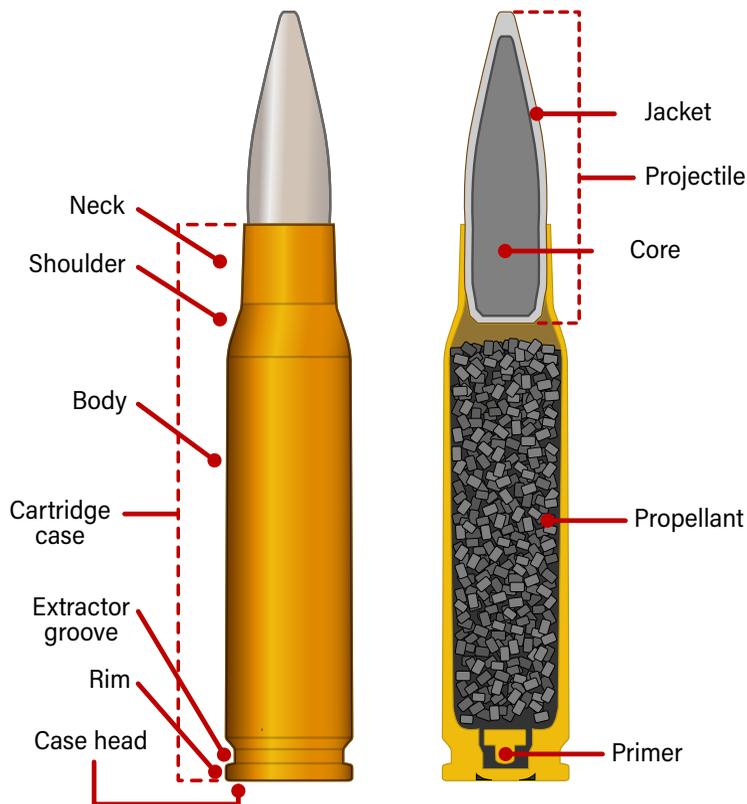


Figure 2.14 Cross-sectional diagram showing key components of a contemporary (rimless, centrefire) rifle cartridge, in this case a 7.62 × 51 mm cartridge (source: ARES).

61 After several false starts in the late 20th century to present, viable high-pressure centrefire ammunition (i.e., modern rifle and handgun cartridges) utilising a lightweight polymer case is now available and seems likely to proliferate. Some are of conventional design, whilst others represent an adaptation of the ‘cased telescoped ammunition’ (CTA) concept first developed for medium- and large-calibre ammunition, named for its distinctive cylindrical case entirely enclosing the projectile. Note that ‘caseless’ ammunition, in which the projectile is encased in its own propellant, was developed during the Cold War era but at present appears to represent a technological dead-end (Jenzen-Jones & Fitch, 2019; Jenzen-Jones, 2016).

62 Cartridge cases made from alternative metals, such as aluminium, are sometimes encountered, as are steel cartridge cases clad with other metals, such as copper or gilding metal (Jenzen-Jones, 2018). Composite cartridge cases, sometimes made from a combination of polymer and metal components, or two or more different metals—such as the .277 Fury with its so-called ‘bimetallic’ cartridge case (not to be confused with earlier use of the term to refer to copper-clad steel and similar materials)—are also increasingly commonplace (Jenzen-Jones, 2019; Jenzen-Jones & Moss, 2020).

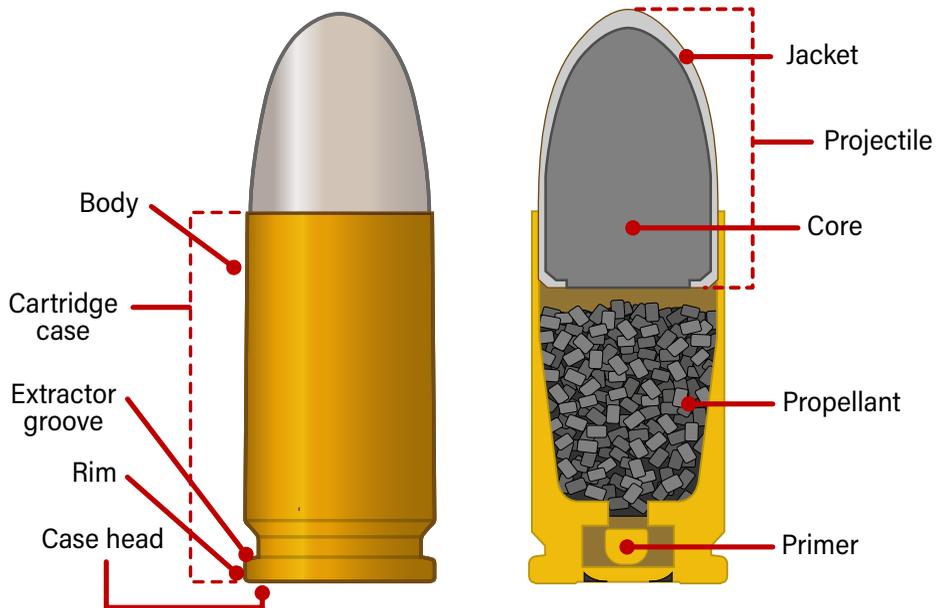


Figure 2.15 Cross-sectional diagram showing key components of a contemporary handgun cartridge, in this case a 9 × 19 mm cartridge (source: ARES).

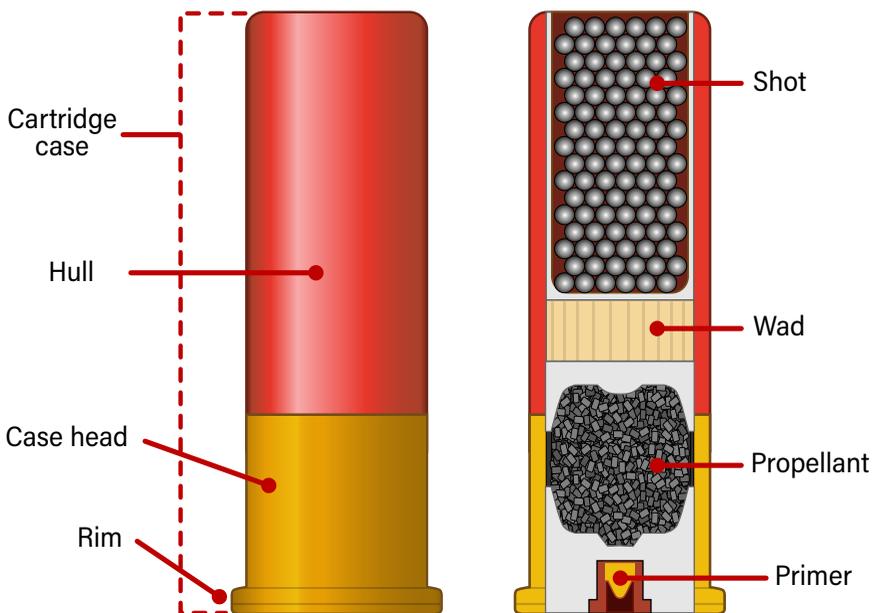


Figure 2.16 Cross-sectional diagrams showing key components of a contemporary shotgun cartridge, in this case a 12-gauge (18.5 mm) shotgun cartridge (source: ARES).

ARCS does not further divide small-calibre cartridges according to their common uses, but there are several frequently used terms that are found within the ARCS document and in more general usage. These distinctions are based upon measurable characteristics of a given cartridge, particularly overall cartridge length and muzzle energy. Common cartridges in civilian use vary significantly between nations.⁶³ In many countries, the cartridges in widespread civilian use reflect those in service with the military or law enforcement agencies. In other countries, military cartridges are restricted or proscribed by law. In Pakistan, for example, weapons originally chambered for cartridges in 'military' calibres are sometimes modified to fire ammunition not restricted under state law (Yasin, 2013). Most small-calibre cartridges can be divided into three broad categories: handgun cartridges (sometimes known as 'pistol-calibre cartridges'), rifle cartridges (sometimes referred to as 'rifle and machine gun cartridges'), and shotgun cartridges. Handgun and rifle cartridges are almost always designed to engage with the rifling in a firearm's bore. Shotgun cartridges are, conversely, most often designed to fire projectiles compatible with a smoothbore barrel (Jenzen-Jones, 2019).

Rifle Cartridges

During the first half of the 20th century, most of the world's armed forces had standardised on a single service rifle and machine gun cartridge, most of which would today be considered 'full-power rifle cartridges' in the 7.5 to 8 mm range.⁶⁴ During the Second World War, the German military introduced an influential cartridge-and-rifle combination that paired a relatively lightweight, selective-fire automatic rifle fed from a detachable box magazine with a cartridge intermediate in size, weight, and power between handgun cartridges and the full-power rifle cartridges that preceded it (Jenzen-Jones, 2021). Cartridges in this range are today known as 'intermediate-calibre rifle cartridges'. This combination would go on to typify the so-called 'assault rifle' concept, and has influenced automatic rifle designs to the present day (Jenzen-Jones, 2016; 2017a). The Soviet Union adopted the 7.62 × 39 mm intermediate-calibre rifle cartridge in 1943, and this round remains in widespread use today (Ponomarev, 2004). In the early 1960s, the United States adopted the 5.56 × 45 mm cartridge, which was the first 'small-calibre, high-velocity' (SCHV) rifle cartridge to be widely issued for military service. Best considered a sub-type of intermediate-calibre rifle cartridges, the smaller projectile diameter of SCHV rifle cartridges contributes to longer range and reduced weight compared with predecessor intermediate-calibre cartridges, whilst terminal effectiveness is maintained by increasing the projectile velocity (Jenzen-Jones, 2021). Recent trends in cartridge development and military trials demonstrate increasing interest in 'general-purpose-calibre' cartridges, which are intended to replace the current two-calibre system. No major military has yet transitioned to a general-purpose calibre, although testing continues (Jenzen-Jones, 2017a; 2019; Jenzen-Jones & Fitch, 2019, pp. 28–32; Jenzen-Jones & Moss, 2020). *Table 2.1* and *Figure 2.17* show some common rifle-calibre cartridges.

63 This section adapted from Jenzen-Jones, 2021a.

64 Some nations instead adopted cartridges around 6.5 mm in diameter. Later, these nations almost invariably adopted supplementary cartridges in the range of 7.7–8 mm (Williams, 2015).

Rifle cartridge

A small-calibre cartridge typically fired from long guns with a rifled bore, and generally having an overall length of 45 mm or greater.⁶⁵

Full-power rifle cartridge

A rifle cartridge generating more than 2,600 J of muzzle energy when fired from a barrel having a minimum length of 400 mm (approximately 16 inches).⁶⁶

Intermediate-calibre rifle cartridge

A rifle cartridge generating between 1,300 and 2,600 J of muzzle energy when fired from a barrel having a minimum length of 400 mm (approximately 16 inches).

Small-calibre, high-velocity (SCHV) rifle cartridge

An intermediate-calibre rifle cartridge of less than 6 mm in calibre which achieves a muzzle velocity of at least 800 m/s.

Table 2.1 – Dominant Rifle Cartridges in Military Service

Cartridge designation	Country of origin	Projectile weight (g)	Muzzle velocity (m/s)	Muzzle energy (J)
7.62 × 54R mm	Russian Empire	9.5	845	3,400
7.62 × 51 mm	United States	9.5	838	3,340
7.62 × 39 mm	Soviet Union	7.9	715	2,020
5.8 × 42 mm	China (PRC)	4.6	900	1,900
5.56 × 45 mm	United States	4.0	950	1,800
5.45 × 39 mm	Soviet Union	3.4	900	1,420

Note: All muzzle velocity and muzzle energy figures are approximations and vary according to barrel length, cartridge type and loading, and other factors.

Sources: Ness & Williams, 2015; Jenzen-Jones & Fitch, 2019.

65 Sometimes referred to as a 'rifle-calibre cartridge' or by the collective term 'rifle and machine gun cartridges'

66 Considerable variation in muzzle energy and velocity may be encountered with rifle barrels of different lengths, hence the need for a minimum length standard, in this case set at a common 400 mm (16 inch) standard.



Figure 2.17 Dominant rifle cartridges in military service globally, L-R: 5.56 × 45 mm; 7.62 × 51 mm; 7.62 × 39 mm; 5.45 × 39 mm; 7.62 × 54R mm; and 5.8 × 42 mm (source: Jack Dutschke/ARES).

Handgun Cartridges

Due to the physical limitations of handgun magazines (typically fitting within the pistol grip of a weapon), handgun cartridges are limited in overall length and, to a lesser extent, in diameter. As a result, most handgun cartridges are significantly less powerful than rifle cartridges and can achieve their optimum performance from a much shorter barrel. Consequently, handgun ammunition generally has a shorter effective range than rifle ammunition (typically up to 100 m) (Jenzen-Jones, 2019; 2021). Some handgun-calibre cartridges can be effective up to 150 m or further, particularly in rifles or sub-machine guns with longer barrels (ARES, 2017a). Additionally, when intended for use in a SMG or rifle, handgun cartridges are sometimes loaded to higher pressures which, in conjunction with the longer barrel, may deliver increased performance (Popenker & Williams, 2012). Whilst rifle cartridges were largely standardised by most nations in the 20th century, a wide range of handgun cartridges were adopted by various services and agencies in different countries. Later in the 20th century, many NATO and other western countries widely adopted the 9 × 19 mm and .45 ACP cartridges, whilst former Warsaw Pact nations largely standardised on the 9 × 18 mm cartridge (Jenzen-Jones, 2021). *Table 2.2* and *Figure 2.18* show some common handgun cartridges.

*Handgun cartridge*⁶⁷

A small-calibre cartridge typically fired from handguns with a rifled bore, and generally having an overall length of less than 60 mm.

*Small-calibre, high-velocity (SCHV)*⁶⁸ *handgun cartridge*

A handgun cartridge of less than 6 mm in calibre which achieves a muzzle velocity of at least 600 m/s when fired from a barrel having a minimum length of 100 mm (approximately 4 inches).

Table 2.2 – Selected Common Handgun Cartridges

Cartridge designation	Country of origin	Projectile weight (g)	Muzzle velocity (m/s)	Muzzle energy (J)
.45 ACP (11.43 × 23 mm)	United States	14.9	280	584
9 × 19 mm	Germany	8.0	440	774
9 × 18 mm	Soviet Union	6.1	310	348
.38 Special (9 × 29.5R mm)	United States	9.7	270	366
7.62 × 25 mm	Soviet Union	5.5	540	802
5.7 × 28 mm	Belgium	2.0	715	511
4.6 × 30 mm	Germany	2.0	720	520

Note: All muzzle velocity and muzzle energy figures are approximations and vary according to barrel length, cartridge type and loading, and other factors.

Sources: Barnes & Woodard, 2016; Ness and Williams, 2015; Jenzen-Jones, 2018.



Figure 2.18 Some common handgun cartridges, left to right: 9 × 19 mm; 9 × 18 mm; 7.62 × 25 mm; .38 Special (9 × 29.5R mm); .45 ACP (11.43 × 23 mm); 5.7 × 28 mm; and 4.6 × 30 mm (source: Jack Dutschke/ARES).

⁶⁷ Sometimes referred to as a 'handgun-calibre cartridge' or a 'pistol-calibre cartridge'.

⁶⁸ Note that the term 'SCHV cartridge' usually refers to rifle cartridges, and so the 'handgun' qualifier is necessary when referring to the relatively limited number of SCHV cartridges that may be readily classified as handgun cartridges.

Shotgun Cartridges

Shotgun cartridges (sometimes called ‘shotgun shells’ or ‘shotshells’⁶⁹) are low-pressure, relatively large-bore cartridges fired from shotguns. They typically contain shot, rather than single projectiles (the latter are generally called ‘slugs’, rather than ‘bullets’, when fired by shotguns) (Jenzen-Jones, 2019). Historically, shotgun cartridges used paper cartridge case bodies (‘hulls’) with brass case heads, or cartridge cases made entirely from brass or other metals. Today, plastic hulls are used for almost all shotgun cartridges. Shotgun ammunition can sometimes be hard to identify, as many third-party producers supply cases (and their components, such as hulls and brass case heads) to the manufacturers of complete cartridges (Jenzen-Jones, 2018). The overwhelming majority of shotgun cartridges produced and used today are 12-gauge cartridges, although other calibres are available. Other sizes still in somewhat frequent use include .410 bore, 28 gauge, 16 gauge, and 10 gauge, as well as other specialist calibres. *Figure 2.19* shows some typical shotgun cartridges. The 12-gauge shotgun cartridge is available in a wide range of loadings, and is used for everything from shooting clay pigeons or hunting to breaching doors or firing less-lethal projectiles (Jenzen-Jones, 2021). Unlike most modern cartridges, the overall length of a shotgun cartridge may vary according to loading.

Shotgun cartridge

A low-pressure, relatively large-bore cartridge designed for use in a shotgun and often containing multiple projectiles (‘shot’).⁷⁰



Figure 2.19 A variety of shotgun cartridges, left to right: .410 bore; 28 gauge; 20 gauge; 16 gauge; 12 gauge; 10 gauge; 4 gauge. Note that case lengths can change depending on loading (sources: Collectible Ammunition; Five Star Auctions).

⁶⁹ The term ‘shotshells’ has also been applied to various cartridges containing shot, not just those fired from shotguns. More generally, the term ‘shell’ has a variety of meanings, so ‘shotgun cartridges’ is the preferred term (Jenzen-Jones, 2019).

⁷⁰ Shotgun cartridges are sometimes fired from weapons classified as handguns, although this is uncommon.

Long Guns [Group]

Long gun

A **firearm** which is grasped by placing the **control hand** and **support hand** in different locations, and which is typically fitted with a **buttstock** intended to be braced against the user's shoulder when fired.

Long guns⁷¹ are distinguished from **handguns** by their intended use from unsupported positions (e.g., standing, kneeling, prone) by grasping the weapon with two hands, typically using the shoulder as the primary means of stabilising the **firearm**.⁷² Handguns cannot be supported in the same manner (without an additional **buttstock** or similar device). Long guns may be fired without the use of a buttstock, however—many designs include folding or retractable buttstocks which may not be employed by the user. A small number of long guns do not have a buttstock at all.⁷³ They may also be mechanically supported or even **mounted** in certain use cases. Long guns are generally chambered for either **rifle cartridges** or **shotgun cartridges**,⁷⁴ although some may be chambered for **handgun cartridges**, including **sub-machine guns** and a subset of **semi-automatic** rifle designs popularly referred to as '**pistol-calibre carbines**'.

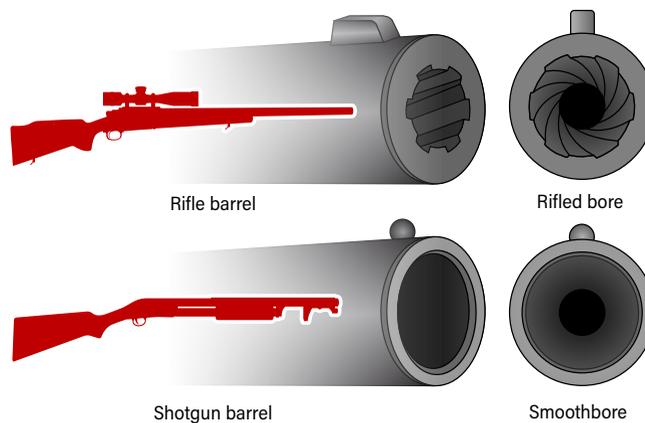


Figure 2.20 Comparison between a rifled barrel and a smoothbore barrel (sources: ARES).

71 The term 'shoulder arms' is sometimes used synonymously with 'long guns', however in some contexts the former does not include weapons intended primarily for use from a bipod or tripod (e.g., machine guns). In other contexts, shoulder arms are taken to include weapons other than firearms, such as hand-held grenade launchers, most of which would be classified as light weapons under ARCS (Ferguson, 2015a).

72 This typically means one hand will be used to grasp the grip of the firearm and actuate the trigger, and another will support and steady the weapon by grasping part of the furniture, often the fore-end. In most cases, this means the hands will not be touching.

73 For example, the Mossberg 'Shockwave' line. These, whilst intended to be grasped with two hands in two different locations on the firearm, have no buttstock (Mossberg, 2017).

74 Unsurprisingly, rifled firearms (i.e., man-portable machine guns and rifles) are primarily chambered for rifle cartridges, and shotguns are primarily chambered for shotgun cartridges.

Shotguns [Type]

Shotgun

A **smoothbore long gun**, primarily intended to fire multiple **projectiles** of less than bore diameter ('**shot**').

Shotgun design is driven by the need to fire multiple **projectiles**, each smaller than the **bore** diameter. A smooth bore is necessary to ensure these remain in a compact **shot column** after leaving the **muzzle** of the shotgun—a **rifled** bore would interfere with this. The **shot** fired from these weapons varies widely in size depending upon the intended target, from **shotgun cartridges** (sometimes called 'shotshells' or, colloquially, just 'shells') containing hundreds of very small pellets (**birdshot**) to those with a dozen or fewer spherical projectiles, typically of up to .33 **calibre** (8.4 mm) (**buckshot**). Single-projectile (**slug**) and other special-purpose **cartridges** (see below) are frequently used, but do not change the categorisation of the weapon as a shotgun provided it retains a smoothbore **barrel**. Some shotgun designs feature easily interchangeable barrels intended to suit the needs of the shooter. These often include rifled barrels for use with slugs. If such a barrel is fitted, the weapon in question is no longer considered a shotgun (it would instead be considered a **rifle**, see below), although such a change cannot always be readily confirmed without close inspection. Conversely, rifled arms may be used to fire shot cartridges, for specialist purposes such as riot control or vermin control—this does not make them shotguns.⁷⁵

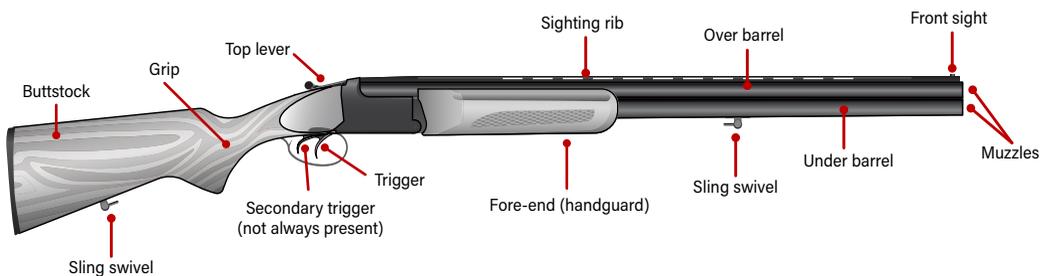


Figure 2.21 Typical parts of a break-open shotgun, in this case a over-and-under, double-barreled shotgun (sources: ARES).

Harder to classify are firearms with partially rifled bores, which include a minority of special hybrid designs (notably Holland & Holland's 'Paradox' system) and the more commonly available aftermarket option of fitting a smoothbore shotgun with a rifled choke tube (Greener, 1897, p. 379; Warlow, 2011, p. 133). In both cases, the resulting firearm exhibits partial rifling (at the muzzle end of the barrel) that permits the use of either shot or slugs. As the **gun's** bores are not fully rifled, these

⁷⁵ Some grenade launchers are also smoothbore designs, although these are addressed in the Light Weapons section.

are deemed to remain ‘shotguns’ for the purposes of ARCS.⁷⁶ The same is true of the most common combination firearm, known as the ‘Drilling’—a German design of sporting gun comprising two smoothbore barrels and a small-calibre rifle barrel mounted underneath. Although strictly speaking a hybrid shotgun/rifle, its design lineage and sporting purpose are both dictated by its smoothbore barrels. In the rare case that a combination weapon is fitted with an equal or greater number of rifled barrels (e.g., with a single smoothbore barrel and two rifle barrels, or with two barrels of each type) it would be classified as a rifle. In any event, explanatory notes would be required.

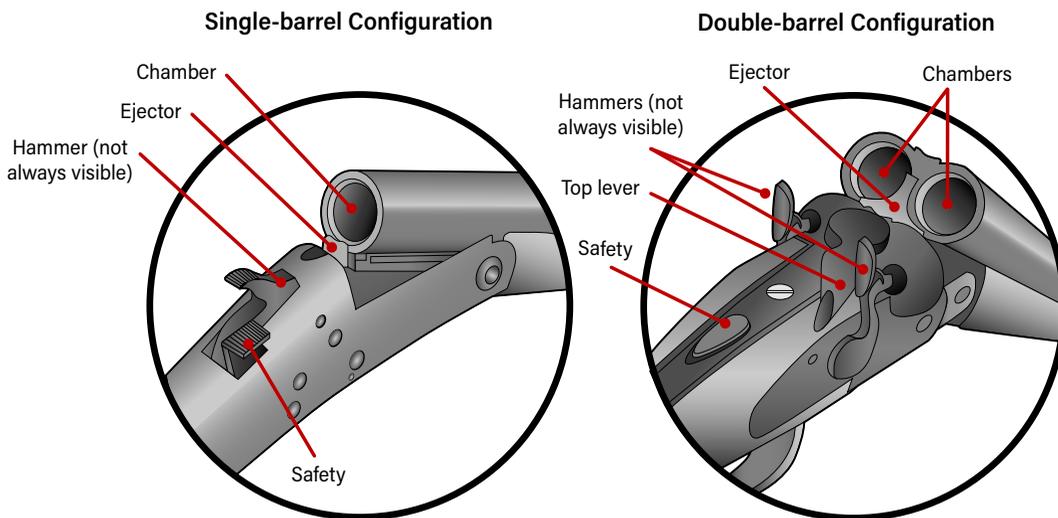


Figure 2.22 Detail diagrams showing typical features of break-open shotguns, with the actions open. Left: a single-barrel design; right: a side-by-side, double-barrel design. Note that not all break-open shotguns have external hammers (see Figure 2.21, an over-and-under, double-barrel design with internal hammers) (sources: ARES).

To accommodate a broad range of [ammunition](#), shotguns are typically larger in bore size than other small arms, commonly ranging from .410 bore (10.4 mm) to 10 gauge (19.7 mm).⁷⁷ Because of their relatively large calibres, shotguns are often used for firing alternative types of projectiles, including RCA, [less-lethal](#) impact projectiles, [illuminating flares](#), and more. Shotguns may be fitted with a slight constriction at the muzzle to alter the spread of the pellets being fired, known as a choke tube or ‘choke’. Choke is not rifling, however, and does not enhance [accuracy](#) or [precision](#)

⁷⁶ Historically, the British view has been to treat such firearms as rifles (Greener, 1897, p. 379; Theobald, 2012).

⁷⁷ Even larger bore shotguns have been used in limited situations, including ‘punt guns’ of well over 50 mm or more in calibre for commercial or sporting fowl shooting (Richards & Novorol, 2018; Willock, 1988). One modern example of a shotgun chambered for a calibre of more than 20 mm is the Russian KS-23 Drozd (23 mm; approximately 4 gauge). These are in limited service with security forces and a civilian version was offered at one time (Popenker, 2018; TOZ, 2004).

per se. Shotguns are popular with civilians (primarily for hunting and sports shooting, but also for home defence) but see only very limited, specialist applications in military service. Shotguns have been traditionally popular with law enforcement due to their increased lethality over handguns and their ability to fire different cartridge types for different applications (e.g., lethal and less-lethal rounds). In some countries and for specific roles, however, shotguns have been replaced by rifles in law enforcement service.

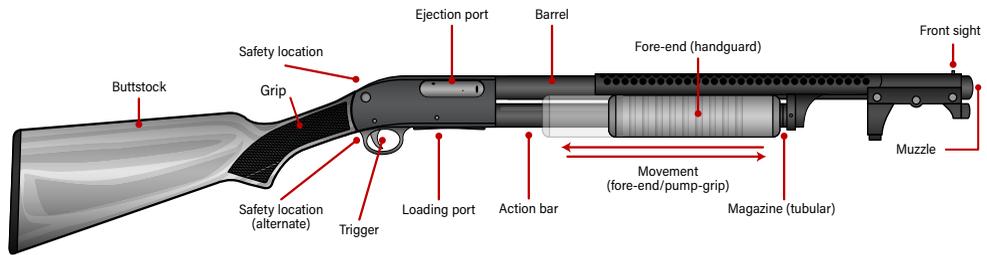


Figure 2.23 Typical parts of a pump-action shotgun (sources: ARES).

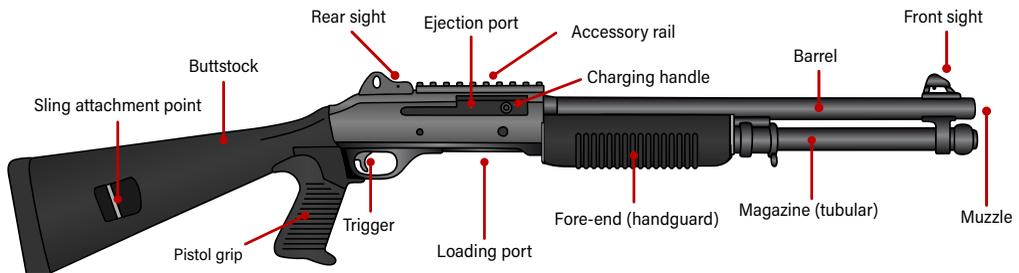


Figure 2.24 Typical parts of a self-loading shotgun (sources: ARES).

Manually Operated Shotguns *[Sub-type]*

Manually operated shotgun

A **shotgun** with an **operating system** which relies on the user, rather than the **chemical energy** contained within a **cartridge**, to **extract** and **eject** fired **cartridge cases** and load new cartridges.

Due to their low cost and prescribed or traditional use for civilian utility purposes (e.g., vermin control)—as well as for some forms of hunting and in certain shooting sports—the vast majority of shotguns in use worldwide are **manually operated**. They may be identified by the presence of a visible top lever (for break-open guns),⁷⁸ pump-grip (for **pump-action** guns; to the fixed fore-end of an equivalent **self-loading** gun), under-lever (for **lever-action** guns; usually an enlarged, pivoting trigger guard),⁷⁹ turn-bolt (for **bolt-action** guns), revolving cylinder (for **revolver-type** guns), or other external means of **operation**. Self-loading models with manually operated modes should be treated as self-loading.⁸⁰ Many manually operated shotguns are non-**repeating**, reloaded by hand after one shot per loaded barrel. **Magazine-fed** models typically feed from a tube magazine located under the barrel.



78 Some break-open shotguns may be ‘side-lever’ or ‘under-lever’ designs, but top-lever designs are the most common (Dallas, 2008; Crudgington & Baker, 2011a; 2011b; Greener, 1897; Taylor, 2015).

79 Or a similar component located adjacent to the trigger guard.

80 Such weapons are usually intended for law enforcement, where the manually operated mode can be used with cartridges that do not generate enough recoil to cycle the weapon’s action, such as certain less-lethal cartridges (see, for example: Thompson, 2011; NZ Army, 2011).



Figure 2.25 (Opposite page, top to bottom) *Browning B525 Heritage Hunter 20M (20 gauge), Mossberg Model 183KE (.410 bore), Winchester 1887 (10 gauge). (This page, top to bottom) SWD Inc. Street Sweeper (12 gauge), Mossberg 590 Shockwave, Adler Arms A-110 (shortened variant; 12 gauge), KelTec KSG Tactical (12 gauge), Benelli Nova Tactical (12 gauge) [not to scale] (sources: Browning; Sunshine Coast Gun Shop; Rock Island Auction Company; O.F. Mossberg & Sons; Adler Arms; KelTec USA, N.R. Jenzen-Jones/ARES; Benelli USA).*

Self-loading Shotguns [Sub-type]

Self-loading shotgun

A **shotgun** that makes use of the **chemical energy** stored in a **cartridge** to **cycle** the weapon's **action**, **extracting** and **ejecting** the **cartridge case** immediately after firing, and **chambering** a new cartridge from the weapon's **magazine**.

Self-loading shotguns have become more popular in recent decades for sporting and other civilian purposes, and are also found in limited military use for specialist purposes such as breaching doors. They are increasingly common in law enforcement use. Self-loading shotguns are commonly gas-, recoil-, or inertia-operated. Tubular **magazines**, typically located under the **barrel**, are the most common **feed mechanism**, but detachable box magazines are increasingly common. As with **semi-automatic** rifles and handguns, semi-automatic shotguns are sometimes erroneously referred to as 'automatic shotguns' (Jenzen-Jones, 2021a).⁸¹ True **automatic** shotguns are rare.



⁸¹ Additionally, self-loading shotguns are sometimes called 'auto-loading shotguns' or 'autoloaders', which may also generate confusion (see, for example: Remington, n.d.).



Figure 2.26 (Opposite page, top to bottom) Beretta A300, Browning A5 Hunter, Benelli M4 Tactical, Adler Arms HT-304. **(This page, top to bottom)** Izhmash Saiga-12 (12 gauge), Atlas Forces Rewold, Franchi SPAS-12, (12 gauge), Daewoo Precision Industries USAS-12 (12 gauge) [not to scale] (sources: Beretta; Browning; Benelli USA; Adler Arms; N.R. Jenzen-Jones/ARES; Atlas Forces; Royal Armouries; Wikimedia Commons).

Rifles [Type]

Rifle

A **long gun** with a **rifled bore**, primarily intended to fire individual bore-diameter **projectiles** ('bullets').

The term 'rifle' broadly describes any **firearm** with a **rifled bore** and a **buttstock**, which is designed to be used with two hands. These weapons are **chambered** for **calibres** up to 20 mm (the upper calibre limit for **small arms** under ARCS), with typical effective ranges from 50 m to more than 1,000 m. 'Rifle' has also been used historically to refer specifically to a subset of these weapons, typically characterised by a comparatively long **barrel** and either a **manual** or **semi-automatic operating mechanism**. Traditionally, this term has been used for the standard infantry firearm, although many armies now issue short-barrelled and/or **automatic** rifles (sometimes called '**carbines**' or '**assault rifles**'⁸²) for this purpose. Note that, despite widespread use of the term '**rifle cartridge**' to imply a **full-power** or **intermediate-calibre cartridge**, many rifles are chambered for **handgun cartridges**, such as the popular .22 LR cartridge. Calibre is itself, therefore, not a useful defining characteristic, save for the limitations of the small arms Class.⁸³

Rifling typically takes the form of two or more spiral '**grooves**' with corresponding raised tracks ('**lands**') running down the length of the **barrel**. These engrave into the projectile—which is necessarily slightly larger than the bore—forcing the projectile to spin as it travels. The rate of this spin (usually known as 'twist rate') varies substantially between rifles of different design and calibre, but is typically one revolution in 150–1,200 mm.⁸⁴

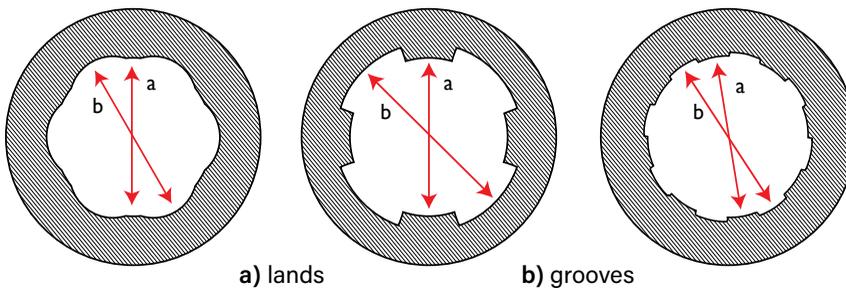


Figure 2.27 Examples of different rifling patterns, shown via the cross-section of a nominal bore. The features have been exaggerated for clarity (source: ARES).

82 No universal definition of an 'assault rifle' exists and the term is nebulous at best (Ferguson, 2020; Jenzen-Jones & Ferguson, 2018; ARES, 2017). Nonetheless, as a working definition, ARES considers the term to refer to selective-fire, automatic rifles fed from detachable magazines and chambered for an intermediate-calibre rifle cartridge (see **Small Arms Ammunition Terminology**, p. 42).

83 That is, in distinguishing a small arm from a light weapon (e.g., a 'rifle' from a 'light cannon').

84 Note that some patterns of rifling may be difficult to detect. Silicone casting of the bore at the muzzle or chamber end may assist in determining the style and twist rate of a weapon's rifling.

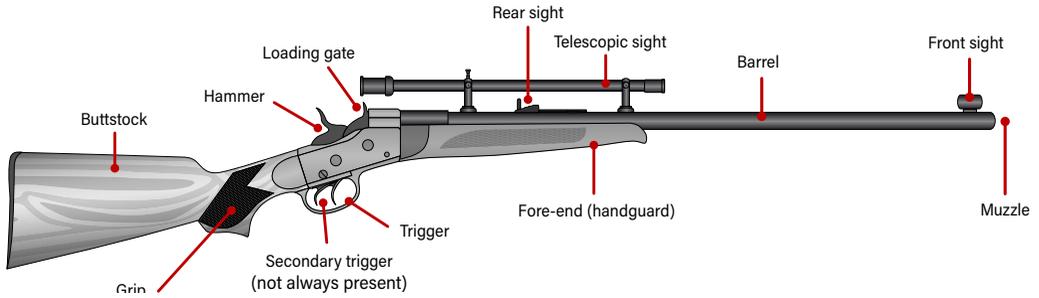


Figure 2.28 Typical parts of a single-shot rifle, in this case fitted with an older style of telescopic sight (sources: ARES).

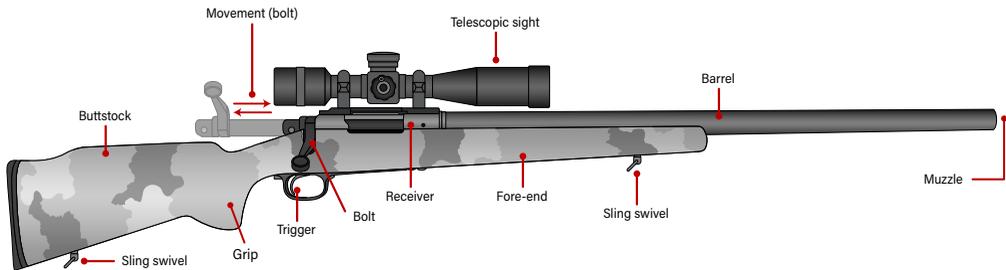


Figure 2.29 Typical parts of a bolt-action rifle, in this case fitted with modern style of telescopic sight (sources: ARES).

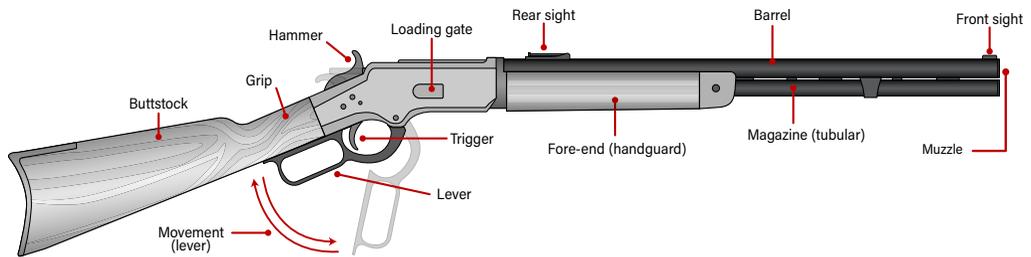


Figure 2.30 Typical parts of a lever-action rifle (sources: ARES).

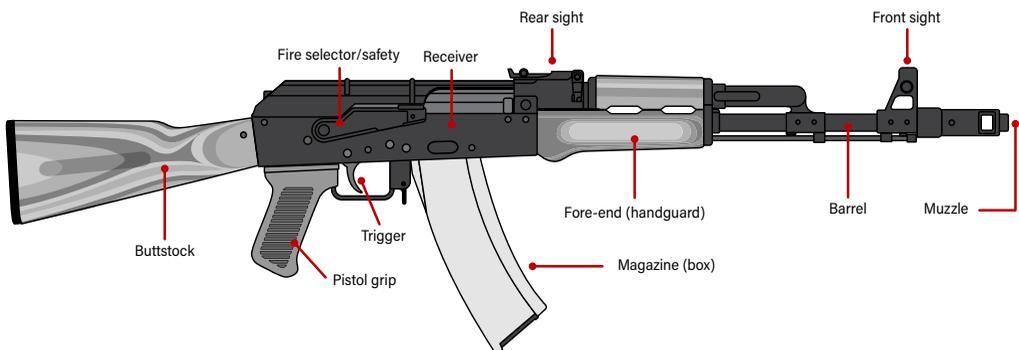


Figure 2.31 Typical parts of a self-loading rifle, in this case a select-fire design with a detachable box magazine (sources: ARES).

Carbines

The term ‘carbine’ is an elastic one that may describe everything from a semi-automatic variant of what would otherwise be considered a sub-machine gun, to a full-power rifle with a relatively short barrel. As barrel lengths have reduced over time, the baseline of what is considered ‘short’ has also been subject to change (Ferguson et al., 2015). Generally, any short and compact rifle may be considered a carbine—be it self-loading or manually operated. Whilst the term may otherwise be technically obsolete, some manufacturers and military forces will use the terms ‘carbine’ and ‘rifle’ to distinguish between shorter- and longer-barrelled weapons of the same model or family. For example, the U.S. military has the M16 ‘Rifle’ and M4 ‘Carbine’, which vary primarily in barrel length (U.S. Army, 1991; USMC, 2008). In current usage, the term ‘carbine’ is typically applied to rifles with barrels of 400 mm or shorter, although design lineage remains a factor (Ferguson, 2015a). It is probably for this reason that English-language sources regard the AK series as ‘rifles’—these were *designed* with relatively short 400 mm barrels and so are not typically regarded as carbines. The term ‘carbine’ is also applied to rifles chambered for handgun calibres, including sub-machine gun-style weapons which are restricted to semi-automatic-only operation. These are sometimes known as ‘pistol-calibre carbines’ (ARES, 2017a). Increasingly, barrel length is an optional variable—any rifle may be made or retrofitted with a shorter barrel. Therefore, the term ‘carbine’ is “too imprecise to meaningfully define any particular group of small arms in modern usage and often causes confusion” (Ferguson & Jenzen-Jones, 2018). Most of the time, weapons described by manufacturers or users as ‘carbines’ will be classified as rifles under ARCS.



Figure 2.32 (This page) Imperial Defence Services MG4A5 (5.56 × 45 mm). **(Opposite page, top to bottom)** SIG MCX Rattler (5.56 × 45 mm); MAC Carabine de Cuirassier Modèle 1890 (8 × 50R mm), Angstadt Arms UDP-9 (9 × 19 mm); Winchester M1 Carbine (.30 Carbine), Tula Plant AKS-74U (5.45 × 39 mm) [not to scale] (source: Sig Sauer; N.R. Jenzen-Jones/ARES; Rob Stott).





Manually Operated Rifle *[Sub-type]*

Manually operated rifle

A **rifle** with an **operating system** which relies on the user, rather than the **chemical energy** contained within a **cartridge**, to **extract** and **eject** fired **cartridge cases** and load new cartridges.

Manually operated **rifles** are increasingly rare in military usage⁸⁵ but remain common in civilian hands—this includes large quantities of military surplus rifles as well as dedicated sporting and hunting equivalents. Their means of **operation** are broadly the same as those used in **manually operated shotguns**, including **bolt-action**, **lever-action**, **pump-action**, and (less commonly) **break-open** designs. **Feed devices** include fixed **magazines** fed by a variety of **clips**, detachable box magazines, and (in the case of lever- and pump-action rifles) under-barrel tube magazines. Single-shot rifles are also encountered. Many rifle models are made in a number of variants chambered for different calibres, reflecting the wide range of applications these weapons may have.



⁸⁵ In military service, manually operated rifles are largely restricted to specialist applications, such as precision shooting, or used for training purposes (particularly cadet training). In some cases, self-loading rifle designs may be modified to provide manual operation for training purposes or to render them legal for civilian possession (see, for example: Ferguson, 2020, pp. 442–449).



Figure 2.33 (Opposite page, top to bottom) RSAF Enfield Martini–Henry (locally modified in the Middle East; .577-450 Martini–Henry), Holland & Holland Round Action Rifle (.500-465 Nitro Express), Ishapore Lee–Enfield No. 4 Mk 1 (.303 British), Winchester Model 1873 (.44-40 WCF). **(This page, top to bottom)** RSAF Enfield L98A1 (5.56 × 45 mm), craft-produced bolt-action rifle styled after an AK-family weapon (7 × 57 mm), Remington M2010 Enhanced Sniper Rifle (.300 Winchester Magnum), Accuracy International L115A3 (.338 Lapua Magnum), Barrett M99 (.50 BMG) [not to scale] (source: Miles Vining/ARES; Chloe Tousignant/ARES; Rock Island Auction Company; Barrett Firearms).

Self-loading Rifles *[Sub-type]*

Self-loading rifle

A **rifle** that makes use of the **chemical energy** stored in a **cartridge** to cycle the weapon's **action**, **extracting** and **ejecting** the **cartridge case** immediately after firing, and **chambering** a new cartridge from the weapon's **magazine**.

Self-loading rifles may be **gas-**, recoil-, or—in rare cases—**blowback**-operated. They may be **automatic** or **semi-automatic** in operation, or capable of **selective fire**, and typically **feed** from detachable **magazines**. Self-loading rifles are now the global standard for military service rifles and are increasingly common in other roles (such as precision shooting applications) (Jenzen-Jones, 2017a). They have also found widespread acceptance with both law enforcement organisations (in many cases supplanting **shotguns** and **bolt-action** rifles) and civilian users, whether cosmetically similar to modern military rifles or more traditional in appearance. **Feed devices** mirror those for manually-operated rifles, with a strong bias toward detachable box magazines for those examples designed from the mid-20th century onwards.





Figure 2.34 (Opposite page, top to bottom) Chinese Type 56 Carbine (7.62 × 39 mm), Izhmash SVD (7.62 × 54R mm), Zastava M76 (7.92 × 57 mm), Barrett M107A1 (.50 BMG). **(This page, top to bottom)** SIG AK 53 (7.5 × 55 mm), Zastava M70B1 (7.62 × 39 mm), Kalashnikov Concern AK-101 (5.56 × 45 mm), KelTec SUB CQB (9 × 19 mm), FN Herstal SCAR-H (7.62 × 51 mm), Desert Tech MDR (5.56 × 45 mm) [not to scale] (source: Justin Baird/ARES; Small Arms Survey; Barrett Firearms; N.R. Jenzen-Jones/ARES; Miles Vining/ARES).

Sub-machine Guns *[Type]*

Sub-machine gun

A self-loading long gun chambered for a handgun cartridge and capable of automatic fire.

The purpose of the sub-machine gun is to produce a high volume of fire with minimal recoil at close ranges (typically no more than 100–150 m). These weapons were originally developed for close-quarters combat in the First World War, and proliferated during and after the Second World War as a result of their compact firepower. In modern usage, the sub-machine gun has largely been supplanted by short, self-loading (mostly selective-fire) rifles chambered for more powerful cartridges, although they are still used in significant numbers (ARES, 2017b; Jenzen-Jones, 2017a). Sub-machine guns are chambered for handgun cartridges, and so typically feature barrels that are shorter than most rifles and man-portable machine guns. The relatively low pressures generated by handgun-calibre ammunition make blowback operation⁸⁶ the dominant operating mechanism within this category of firearms (Jenzen-Jones, Ferguson & Williams, 2016).



⁸⁶ A distinction is sometimes made between 'simple' (or 'plain') blowback operation and 'advanced primer ignition' (API) blowback operation, however this technical nuance is not necessary for classification at most levels (for more information on the distinction, see, for example: Williams, 2000, p. 65; Chinn, 1955, pp. 11–29 *cf.* 19–42).

A



Figure 2.35 (Opposite page, top to bottom) Norinco CS/LS06 (9 × 19 mm), Military Industries Corporation MP5 (9 × 19 mm). **(This page, top to bottom)** Veselý V-42 (9 × 19 mm), craft-produced 'Luty' sub-machine gun (9 × 19 mm), Heckler & Koch MP7 (4.6 × 30 mm), Cobray M12 (.380 ACP) [not to scale] (sources: Norinco; Miles Vining/ARES; Chloe Tousignant/ARES; N.R. Jenzen-Jones/ARES).

Man-portable Machine Guns [Type]

Man-portable machine gun

A **self-loading long gun** chambered for a **rifle cartridge** and primarily intended for **automatic** fire from a **bipod** or **mount**.

Man-portable machine guns (sometimes called ‘hand-held machine guns’) are designed to provide substantially greater firepower than **automatic rifles**, whilst remaining portable by a single individual, in contrast to **crew-portable heavy machine guns**. They are heavier than the latter, and, to accommodate this weight and to improve the steadiness of aim, they are intended to be fired from supported positions—typically on the ground or from a **mount** (especially on vehicles). Most man-portable machine guns are fitted with, or can accept, a **bipod** or **tripod**. These **guns** can be fired without support, but this does not change their core purpose and design. They are typically fed from high-capacity **feed devices**; many man-portable machine guns are **belt-fed** weapons.

Traditionally, man-portable machine guns have been further divided into ‘light machine guns’ (LMGs) and ‘general-purpose machine guns’ (GPMGs). There has never been a particularly clear distinction between these terms, although, in recent decades, NATO/Western observers have used ‘LMG’ to refer to man-portable machine guns **chambered** for the 5.56 × 45 mm **cartridge** (and other **SCHV cartridges**) and ‘GPMG’ to refer to man-portable machine guns chambered for the 7.62 × 51 mm cartridge (and other **full-power rifle cartridges**). Other methods of division include the issue of LMGs in some armed forces at the **squad** level, with GPMGs held at the platoon or higher levels. The term ‘medium machine gun’ (MMG) has been used historically, but is not common today.⁸⁷



⁸⁷ This term is generally used to refer to obsolete rifle-calibre machine guns formerly termed ‘heavy machine guns’ but is also effectively a synonym for modern general-purpose machine guns when fitted to a tripod mount. A small number of modern machine guns chambered for calibres intermediate between those fired by man-portable machine guns and heavy machine guns are being marketed using this or related terminology, such as the General Dynamics Ordnance and Tactical Systems Lightweight Medium Machine Gun (LWMMG). This is as lightweight as some GPMGs, but fires appreciably more powerful ammunition (Jenzen-Jones & Moss, 2020; Jenzen-Jones & Fitch, 2019). Portability remains the most useful distinguishing factor between handheld machine guns and heavy machine guns (Jenzen-Jones, 2021a).



Figure 2.36 (Opposite page) Degtyaryov Plant PKM (fitted with Zenitco accessories; 7.62 × 54R mm). **(This page, top to bottom)** Heckler & Koch L86A2 (5.56 × 45 mm), CETME AMELI (5.56 × 45 mm), Israel Military Industries Negev (5.56 × 45 mm), Hotchkiss Modèle 1926 (Ottoman contract; 7.92 × 57 mm), Al-Qadisiya Establishments al Quds (7.62 × 39 mm) [not to scale] (sources: N.R. Jenzen-Jones/ARES; Miles Vining/ARES.).

Small Arms Operating Systems

N.R. Jenzen-Jones & Jonathan Ferguson

Small arms can be operated by a variety of different systems (sometimes incorporating different firing modes) according to their practical application. Some Types of small arms may be restricted to a particular operating system (also known as an ‘action’). Hand-held machine guns and sub-machine guns, for example, must be capable of automatic operation to be classified as such. Some of the actions described below also apply to light weapons, such as heavy machine guns.

Almost all modern firearms follow the same basic cycle of operations. Once loaded with one or more cartridges, the operator pulls the trigger,⁸⁸ causing an internal mechanism to allow the weapon’s firing pin to strike a cartridge’s primer (located in the base of the cartridge). The primer ignites the propellant within the cartridge, which generates rapidly-expanding gases as it burns. The build-up of pressure from the expanding gas within a sealed chamber (the ‘breech’ of the weapon) forces the projectile down the barrel, exiting via the muzzle, and towards the target (see *Figure 2.37*). The discharge of a firearm is accompanied by a blast at the muzzle—usually including a visible flash—and by recoil that is typically perceived by the user (Jenzen-Jones & Ferguson, 2018).

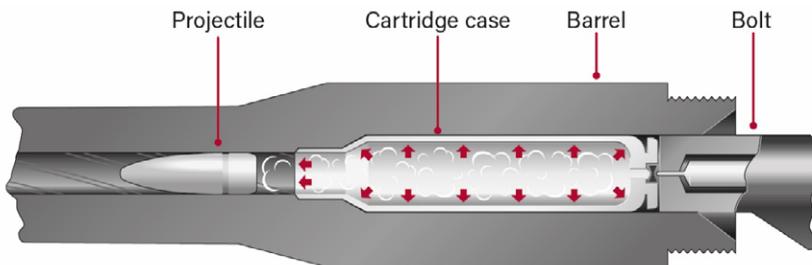


Figure 2.37 *The build-up of gas pressure behind the projectile propels it out of the barrel of the gun. The cartridge case and bolt face provide a gas seal (rearward obturation) (source: Jenzen-Jones & Ferguson, 2018 after Chinn, 1955).*

Small arms operating systems can be broadly divided into two categories: those which are manually operated and those which are self-loading. Manually operated small arms rely on the user to perform key operating actions, whereas self-loading firearms make use of the chemical energy (a form of potential energy) stored within a cartridge to perform these critical actions. The vast majority of firearms in existence today are repeating firearms. In a repeating firearm, the number of cartridges held in the weapon is greater than the number of barrels, one or more cartridges are held elsewhere than the firing chamber, and more than one shot can be fired before the weapon needs to be reloaded.⁸⁹

⁸⁸ Or otherwise activates the trigger of the weapon.

⁸⁹ Break-open weapons are not repeating firearms, whereas bolt-, pump-, and lever-action designs—as well as all self-loading firearms—are most often repeating firearms (ARES, 2017).

Whether employing a manually operated or self-loading action, each cartridge in a repeating weapon is subjected to a similar operating cycle: it is loaded from the feed device (or manually loaded) into the gun's chamber, the bolt is locked to the rear of the breech,⁹⁰ the cartridge is fired, the bolt is unlocked, and the cartridge is then extracted from the chamber and ejected.

Manually Operated Small Arms

Manually operated firearm

A **firearm** making use of an **operating system** which relies on the user, rather than the **chemical energy** contained within a **cartridge**, to **extract** and **eject** fired **cartridge cases** and load new cartridges.

All manually operated firearms rely on the user, rather than the potential (chemical) energy stored within a cartridge, to cycle the weapon. The most common manually operated mechanisms in use with long guns are bolt-action (typically found on rifles) and pump-action (typically found on shotguns) designs. Other varieties include lever-action and break-open operating systems. Handguns may also be manually operated, with the predominant Type using manual actions being the revolver⁹¹ (although bolt-action and break-open handguns also exist).

Break-open firearms feature a barrel or barrels that are unlocked and brought out of alignment with the receiver of the weapon to allow reloading. They are most often found as single- or double-barrel weapons, with shotguns more commonly using this system than rifles. The multiple barrels replace magazine feed as a means of firing multiple shots, and—depending upon the trigger mechanism employed—breaking the firearm may also cock it (as in modern break-open shotguns). Break-open handguns are also in production, although not in general use. The most common variety is probably the derringer, a popular design that has been manufactured for well over 100 years. Derringers most commonly feature two barrels, and are valued for their small size and mechanical simplicity compared to revolvers and self-loading handguns.

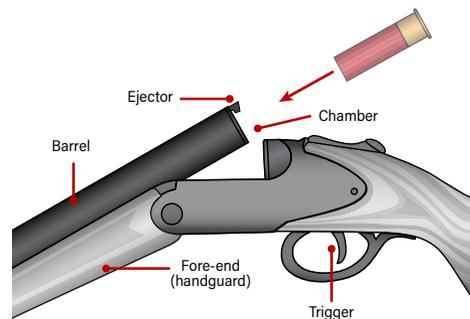


Figure 2.38 A break-open firearm, in this case a shotgun, depicted with the action open (source: ARES).

90 Note that not all weapons use a locked-breech design. The most common unlocked-breech design used in modern firearms is the simple blowback action, in which the bolt is not locked to the breech on firing, being held in place only by its own inertia and the return spring. This is only suitable for relatively low-pressure ammunition, such as handgun or shotgun cartridges, as well as some cartridges for grenade launchers.

91 Some revolving long guns are also made.

Bolt-action firearms can be identified by their long (usually knobbed) bolt handle, which must be manually cycled by the shooter between shots. This usually (but not always) requires lifting the handle up to unlock, pulling the bolt rearward to eject the empty case, pushing it forward to chamber a new cartridge, and then rotating it down some 30–90 degrees to lock the action. Bolt-action firearms can be found chambered for all sizes of cartridge from the smallest rimfire rounds to the largest anti-materiel rounds.

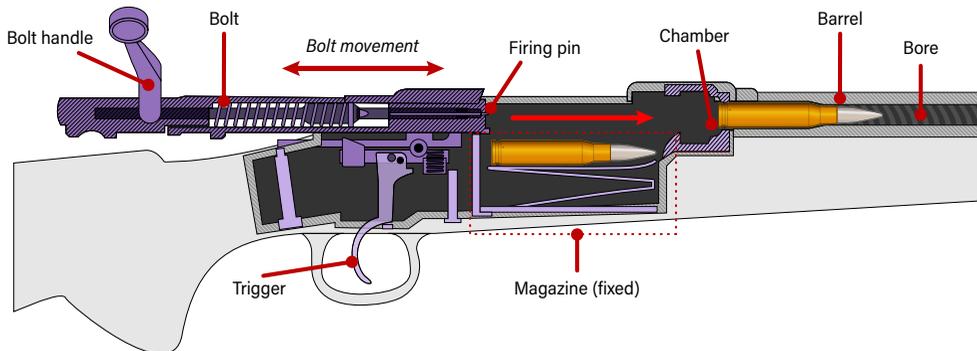


Figure 2.39 A cutaway diagram of a typical bolt-action rifle (source: ARES).

Lever-action firearms can be identified by the lever protruding behind the trigger, typically held in the same hand as the trigger finger. These firearms require the lever to be rotating (most often down and forward) to remove an empty cartridge case, and then returned to the rearward/upward position to chamber a new cartridge. Lever-action firearms are primarily rifles, and have been obsolete in military service since the beginning of the 20th century. Although lever-action handguns were briefly produced in the mid-late 19th century, these should not be confused with revolvers having ring-triggers. The latter are simply a variation on the double-action revolver.

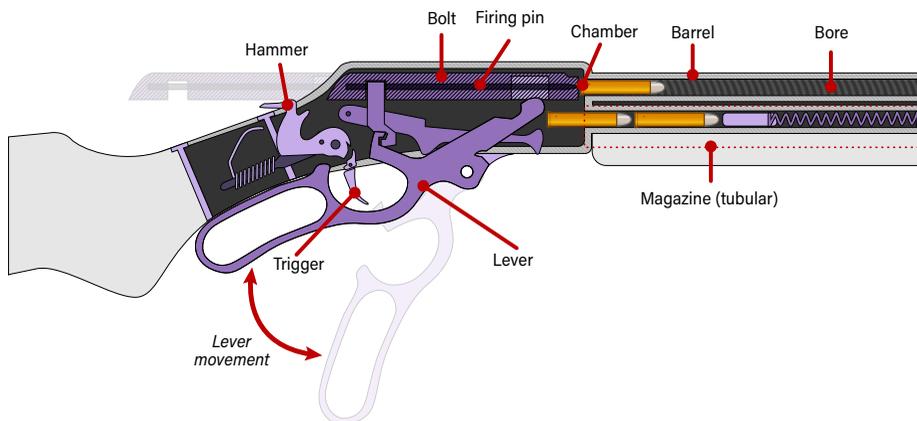


Figure 2.40 A cutaway diagram of a typical lever-action rifle (source: ARES).

Pump-action (sometimes referred to as ‘slide-action’) firearms can be identified by a sliding handgrip, which must be manually cycled—much like a bolt-action—between shots. The process is typically simpler, most often pulling the slide backwards to

remove the empty cartridge case and then pushing it forward to load a new one and lock the action.⁹² Whilst this system is common amongst shotguns, pump-action rifles are much rarer.

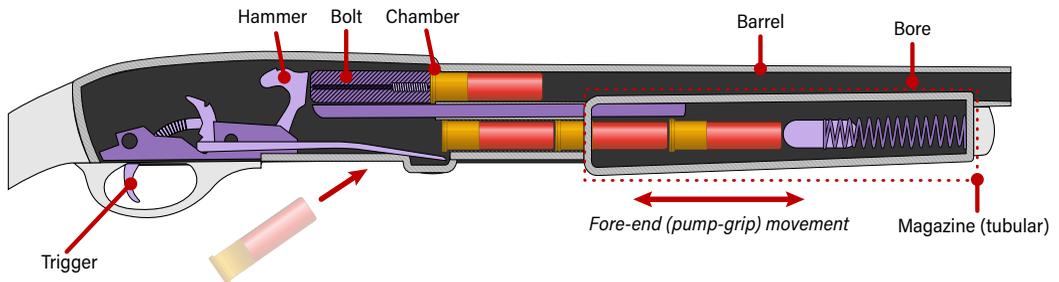


Figure 2.41 A cutaway diagram of a typical pump-action shotgun (source: ARES).

Revolving firearms—known as ‘revolvers’ when this operating system is applied to handguns⁹³—are those with a fixed barrel and a rotating cylinder containing multiple parallel chambers. These are sequentially brought into alignment with the barrel for firing. Although trigger mechanisms are not integral to a firearm operating system, it is important to note that although revolvers with double-action trigger mechanisms may appear superficially to be semi-automatic in operation, in fact it is the force applied by the user (rather than energy stored in a cartridge) that moves chambers into and out of alignment with the barrel and simultaneously cocks the hammer.

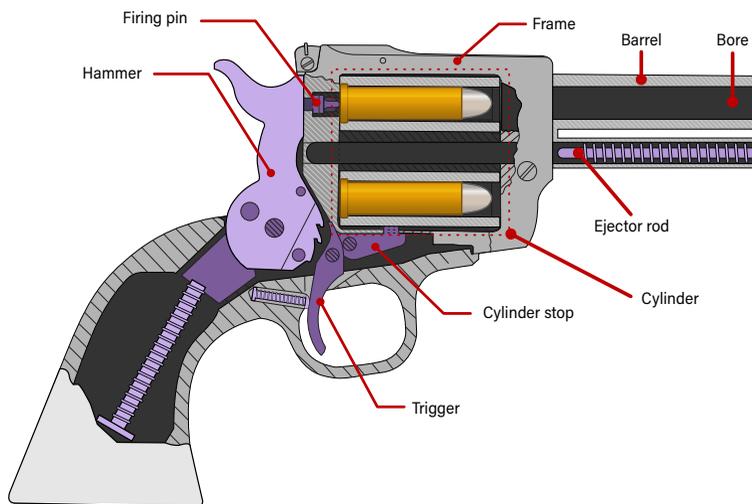


Figure 2.42 A cutaway diagram of a typical revolver (source: ARES).

⁹² Uncommonly, the action may be pushed forward to extract and eject the fired cartridge case, and pulled rearward to load a new cartridge into the chamber. The two varieties are sometimes described as ‘pull-push’ and ‘push-pull’.

⁹³ The term ‘revolver’ has been applied to weapons other than handguns, such as ‘revolver cannon’—a term used to describe a type of autocannon with a series of chambers arranged within a rotating cylinder. Such weapons typically have other commonly accepted names. In the case of the revolver cannon, these include ‘drum cannon’ (Germershausen, 1982, pp. 277–279) and ‘rotary-action cannon’ (Chinn, 1955, pp. 178–209).

Self-loading Firearms

Self-loading firearm

A **firearm** which make use of the **chemical energy** stored in a **cartridge** to **cycle** the weapon's **action**, **extracting** and **ejecting** the **cartridge case** immediately after firing, and **chambering** a new cartridge from the weapon's **magazine**.

Self-loading firearms make use of a wide variety of operating systems. Weapons firing low-powered ammunition frequently utilise a simple blowback action, but more powerful ammunition requires a locked-breech design. This may be recoil-operated, gas-operated, or use some form of retarded blowback or delayed blowback.⁹⁴ In long guns, a gas piston is the most common mechanical system, although recoil- and retarded-blowback designs are also in common use. Self-loading firearms will always have a feed device (most often a magazine) containing multiple cartridges which is normally, but not necessarily, detachable from the weapon. Self-loading long guns typically utilise a single-action trigger mechanism that is cocked as part of the operating cycle. However, self-loading handguns mirror revolvers in ranging between single-action, double-action, and double-action-only mechanisms, as well as hybrid systems which are partially cocked by the energy of firing and partially by the manual pull of the trigger (e.g., Glock's proprietary 'Safe Action' system, now widely imitated).⁹⁵

Most rifles in military service today are self-loading designs capable of automatic fire, as described below. However, semi-automatic-only versions of many of these rifles are made in significant numbers for civilian purchase, typically used for self-defence, hunting, and sporting applications. Distinguishing between the two can be difficult, but is essential because of legal requirements in many jurisdictions.

94 Retarded-blowback and delayed-blowback actions are often conflated, but are distinct (Ferguson, 2020, p. 198; Ferguson et al., 2015). Weapons operating on the delayed blowback principle remain fully locked until peak gas pressures have passed and a safe operating limit is reached, after the projectile has left the muzzle of the weapon (Chinn, 1955, p. 42). By contrast, the term 'retarded blowback' describes a system in which the bolt begins to move rearward immediately after a cartridge is fired, employing a mechanism to impart mechanical disadvantage that slows ('retards') the process, allowing pressures time to drop to within safe operating limits (Chinn, 1955, p. 54). Nonetheless, the term 'delayed blowback' is commonplace today, especially as it applies to so-called 'roller-delayed blowback' weapons, in large part due to Stevens, 2006. The operation of the two systems is similar. Chinn notes that "...an ideal retarding mechanism will approximate the effect of a delay mechanism except that the bolt is not rigidly locked at any time" (Chinn, 1955, p. 57).

95 This is sometimes called the 'striker-fired' system, but the presence of a striker rather than a hammer is not directly relevant to the type of trigger as part of a given operating system. Both hammers and strikers are used to fire a gun by impacting the primer in the cartridge.

Semi-automatic Firearms

Semi-automatic firearm

A self-loading firearm which is capable of firing only one shot with each trigger pull.

Many early military self-loading rifles⁹⁶ were chambered for relatively large, powerful cartridges, resulting in limited capacity magazines and substantial recoil.⁹⁷ In the interests of accuracy and ammunition conservation, these were often mechanically limited to firing only one shot per trigger pull. The vast majority of self-loading handguns have a similar limitation for the same reasons.

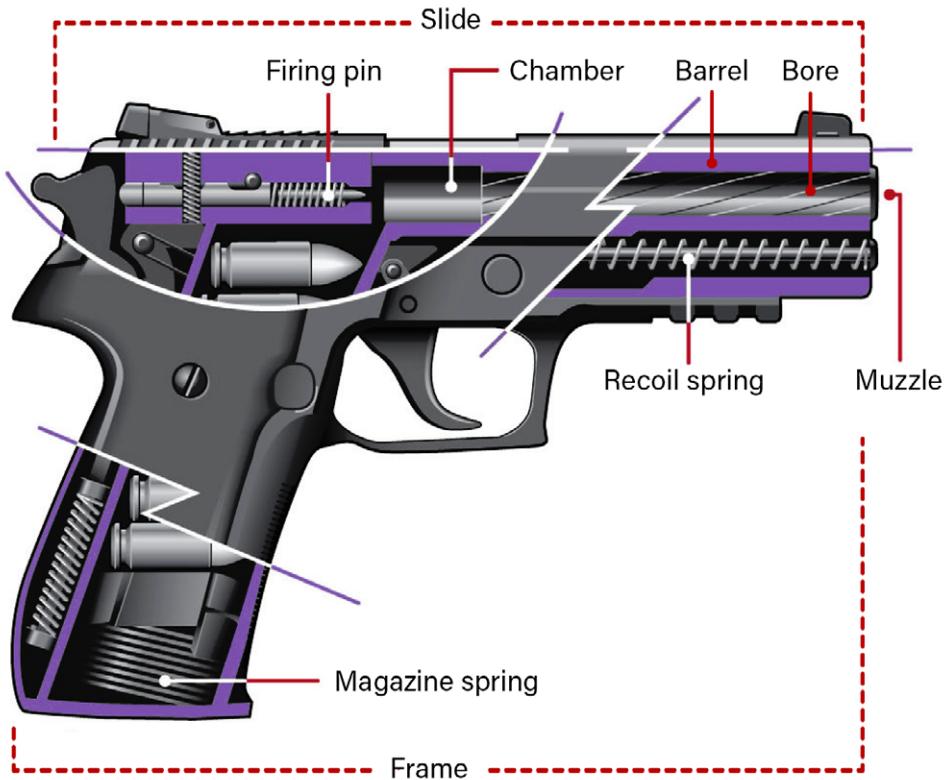


Figure 2.43 A cutaway diagram of a typical self-loading pistol, in this case a semi-automatic example (sources: Small Arms Survey).

96 For example, the American M1 'Garand', German Gewehr 43, and Belgian Model 1949.

97 Much has been written on the transition from full-power cartridges to intermediate-calibre cartridges, which resulted in more automatic infantry arms. See, for example: Jenzen-Jones, 2017a.

Automatic Firearms

Automatic firearm

A self-loading firearm which is capable of firing multiple shots with a single trigger pull.

As previously described, some categories of small arms—most notably sub-machine guns and man-portable machine guns—have automatic function as a prerequisite for classification. Other weapons, such as rifles and, less commonly, self-loading pistols may be produced in similar semi-automatic and automatic variants. Most self-loading rifles in military service today are automatic (sometimes referred to by the redundant term ‘fully automatic’), although they commonly feature a user-operable selector that can limit the weapon to semi-automatic operation when desired. Weapons capable of both semi-automatic and automatic (including ‘burst-fire’) operation are known as ‘selective-fire’ weapons. Semi-automatic fire is typically more accurate and may be used to conserve ammunition. This trend began with the first generation of rifles adopted after World War II and continued through the global adoption of intermediate calibre ‘assault rifles’ (Jenzen-Jones, 2017a).

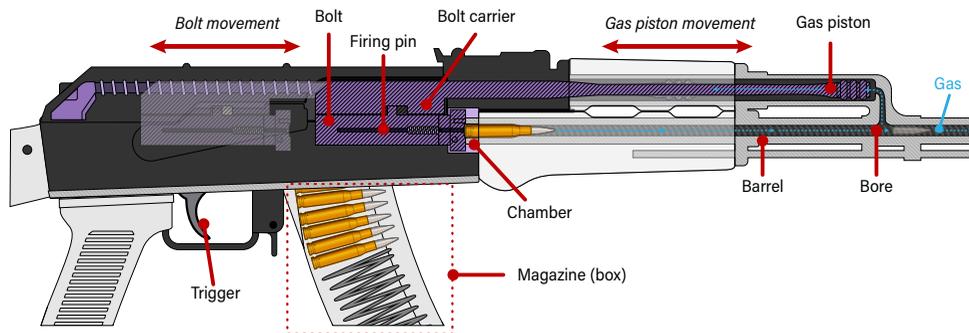


Figure 2.44 A cutaway diagram of a typical self-loading rifle, in this case a gas-operated, selective-fire example (source: ARES).

Automatic handguns (sometimes called ‘machine pistols’⁹⁸) are often, but not always, variants of more common self-loading pistols. They are typically equipped with selector switches allowing the user to choose from semi-automatic or automatic fire. The intention is to retain the compactness and portability of a handgun whilst offering the increased firepower of an automatic long gun. This is a difficult compromise, and for that reason machine pistols remain niche weapons. These handguns require substantial training to use effectively, and nearly all examples feature attachment points for a removable buttstock, allowing for more controllable automatic fire. Muzzle devices intended to combat muzzle climb (‘compensators’)—or barrels ‘ported’ to similar effect—are commonplace.

98 Note that the term ‘machine pistol’ is sometimes used in English (and exclusively in some other languages, such as the equivalent *maschinepistole* in German) as a synonym for ‘sub-machine gun’ (Ferguson, 2015a; ARES, 2017a).

Muzzle-loading Firearms

Muzzle-loading firearm

A **firearm** which does not use self-contained **cartridges**, instead requiring the **separate loading** of **gunpowder** and **projectile(s)** from the **muzzle** end of the weapon.

Prior to the invention of self-contained cartridges, firearms were almost always⁹⁹ loaded by pouring gunpowder into the barrel from the muzzle, followed by (or wrapped in paper along with) a projectile. Muzzle-loading small arms¹⁰⁰ (sometimes known simply as 'muzzleloaders', as distinct from 'breechloaders') have been militarily obsolete for perhaps 150 years, but are sometimes still encountered in conflict zones because of their extreme simplicity and their ability to employ a wide range of projectiles and craft-produced gunpowder. Such weapons, using a simple percussion system (so-called 'Dane guns'), are still made in parts of Africa, and are widely used for hunting, poaching, and defence of property.¹⁰¹ In some cases, similar weapons are still in use which were manufactured 200 years or longer in the past, although this is rare.

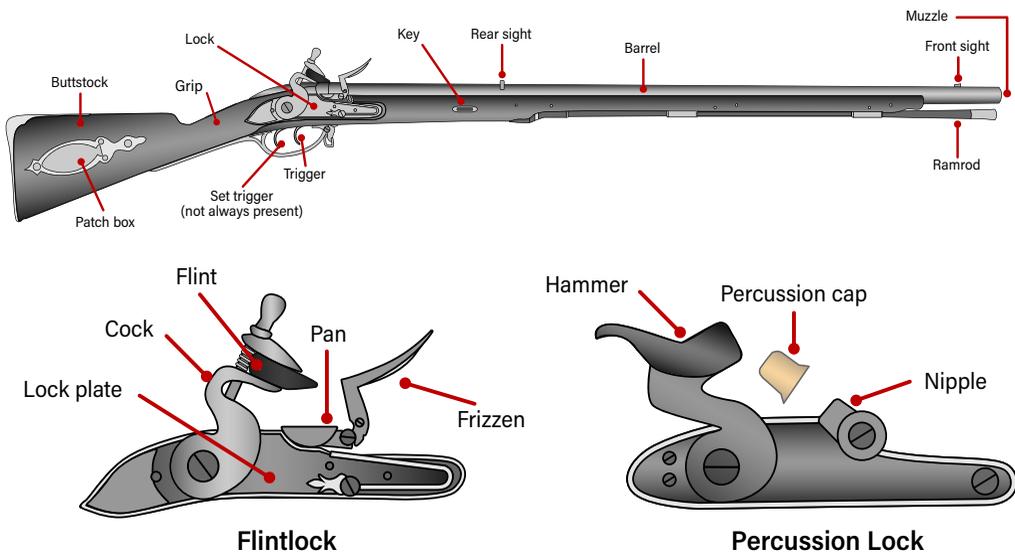


Figure 2.45 Typical parts of a muzzle-loading firearm. Two common lock types, a flintlock and percussion lock, are depicted (sources: ARES).

⁹⁹ Early breech-loading firearms using separately loaded ammunition, whilst rare, were known from at least the 16th century onwards (see, for example: Ffoulkes, 1916, p. 331 & pl. XXXIII).

¹⁰⁰ Muzzle-loading light weapons also exist, especially mortars, but also some grenade launchers, certain recoilless guns, and other weapons. Practically speaking, the term 'muzzleloader' is most often reserved for muzzle-loading firearms.

¹⁰¹ Jenzen-Jones & Ferguson, 2018b, p. 237.

Muzzle-loading arms may be either rifled or smoothbore, with the smoothbore guns capable of firing both individual bore-sized projectiles and multiple sub-calibre projectiles ('shot') through non-rifled barrels.¹⁰² Despite their simple design, generally poor accuracy, and slow rate of fire, these weapons are still quite lethal. Muzzle-loading weapons include both long guns and handguns, and a fully loaded and properly maintained percussion revolver is—within its operating parameters—potentially as deadly as a modern revolver.¹⁰³

Emergent Weapons Technologies

It is not possible to predict exactly what new weapon designs will be developed in coming years and decades, but there is a distinct possibility that new developments will not align with current definitions. The current norms in terms of projectile diameter and muzzle velocity are useful for separating modern firearms into categories at the time of writing, but developments such as electromagnetic rail guns or directed-energy weapons may not conform to these standards. Nonetheless, where physical projectiles are present a description of their diameter and muzzle velocity are likely to remain key technical characteristics for classification.

102 The best known of early smoothbore muzzleloaders is the military musket, but smoothbore guns were common in civilian use, known as 'fowling pieces' or simply 'guns' (the term 'shotgun' being a later development).

103 Note that the 'pepperbox' originated as (effectively) a percussion revolver with an elongated cylinder in place of the fixed barrel (a cluster of rotating barrels, in other words). Although most are muzzle-loading designs and therefore obsolete, modern craft-produced versions exist and these are primarily chambered for self-contained ammunition (see, for example: Hays & Jenzen-Jones, 2018, pp. 71–73).

Defining Light Weapons

N.R. Jenzen-Jones, Jonathan Ferguson, Anthony G. Williams & Tony Salvo

Light Weapons [Class]

Light weapon

A weapon or **weapon system** which may be transported (with its **ammunition**¹⁰⁴ and any critical components¹⁰⁵) and operated by a **crew** of no more than five individuals on foot, weighs 300 kg or less (excluding ammunition) in a firing configuration, and does not meet the definition of a **small arm**.

As a class of arms, light weapons offer far more firepower than small arms but retain a degree of portability (Jenzen-Jones & Schroeder, 2018, p. 168). This class of arms may be carried by individuals or be crew-served (transported and operated by a group of individuals), and are often mounted to vehicles for rapid and flexible deployment. Different light weapons are designed for engaging different types of targets, ranging from personnel to aircraft. As such, light weapons range from extraordinarily simple to highly complex weapon systems, and make use of a variety of operating principles and ammunition types. Light weapons are often described as either ‘direct-fire’ or ‘indirect-fire’ weapons. Direct-fire weapons are aimed directly at the target and are generally employed when a target is visible. Direct-fire light weapons include heavy machine guns, light cannon, recoilless weapons, some rocket and missile launchers, and some grenade launchers.¹⁰⁶ Direct-fire weapons are often more accurate and precise than indirect-fire weapons, but generally have shorter ranges and may fire projectiles with smaller payloads (Cross et al., 2016, p. 43). Indirect-fire weapons are typically employed when the target cannot be observed, is protected by geographic or structural features, or is located a significant distance away. These weapons include mortars, some grenade launchers, some rocket and missile launchers, and larger artillery (Dullum et al., 2017, p. 12).

As manufacturing technology has improved in the past century and with the development of more advanced computerised guidance and optical systems, many weapons have become smaller, more portable, and more effective. Anti-armour capabilities formerly requiring a large-calibre (and therefore heavy) gun with a three-to-five-man crew are now provided by one- or two-man missile systems, and

¹⁰⁴ Whilst there is no readily-accepted understanding of how much ammunition must be carried, it is understood that even a light combat load for some weapon systems will constitute a substantial burden in terms of volume and weight. At a minimum, this figure should include a full weapon load of ammunition (e.g., an entire magazine, complement of rockets, etc.) and, in the case of reloadable weapons, one full reload of the same number of munitions.

¹⁰⁵ Those required for the weapon to function.

¹⁰⁶ Additionally, all small arms are fundamentally direct-fire weapons.

relatively simple weapons—such as grenade launchers and mortars—have become significantly more refined in recent decades (Berman, Jenzen-Jones & Leff, 2017; Jenzen-Jones, 2015a; 2015b). In general, it can be said that capabilities are migrating from heavy weapons into light weapons.

Light Guns *[Group]*

Light Gun

A **light weapon** which uses the combustion of a **propellant** to generate high-pressure gas in a sealed **chamber** in order to accelerate a **projectile** in a controlled manner.

‘Light gun’ is an umbrella term, used within ARCS to refer to various Types of **guns** of considerably greater destructive power than **long guns**, but which meet the definition of **light weapons**, rather than **heavy weapons**. The term should not be confused with other uses of ‘light gun’ such as the (role-based) historical British class of lightweight **artillery**.¹⁰⁷ Light guns may be chambered for **small-calibre** (**heavy machine guns**), **medium-calibre** (**light cannon** and **light grenade launchers**), or **large-calibre** (**light recoilless guns** and most **crew-portable mortars**) **ammunition**. They may be either **direct-fire** or **indirect-fire** weapons. Despite covering a broad range of light weapons, all light guns make use of the combustion of a **propellant** to generate high-pressure gas in a sealed chamber in order to accelerate a **projectile** in a controlled manner.¹⁰⁸

Heavy Machine Guns *[Type]*

Heavy Machine Gun

A **crew-served rifled light gun** primarily intended for **automatic** fire and **chambered** for a **cartridge** of more than 8 mm but less than 20 mm in **calibre**.

Heavy machine guns (HMGs) are bulky and heavy weapons originally intended for sustained fire at medium (300 m) to long (1,000 m +) ranges. To this end, they are typically **belt-fed** and may feature heavy or interchangeable **barrels** (or sometimes even water-cooling) to deal with the high temperatures generated by **automatic** fire, and for effective use must be fired from a mechanical **mount**, usually a **tripod** or vehicular **mount**. A typical **crew** operating on foot consists of a minimum of

¹⁰⁷ The term ‘light gun’ is currently used to describe the British L118 105 mm towed howitzer, a comparatively mobile example of a heavy gun (see **Heavy Weapons**, forthcoming) that may be transported by a medium-weight vehicle or a helicopter (BAE Systems, 2020).

¹⁰⁸ As with small arms, light guns may in future make use of electromagnetic force instead of chemical combustion to propel projectiles (e.g., rail and coil guns).

three operators, one to carry the gun, one the mount, and one or more others to carry and load [ammunition](#) (Ferguson et al., 2015, p. 8). Additional crew members for supplying ammunition are not uncommon. These weapons may be distinguished from [automatic light grenade launchers](#) by the ammunition that they fire, which develops considerably higher [muzzle energy](#) and [velocity](#) (typically greater than 800 m/s). HMGs are distinguished from [light cannon](#) by their relatively smaller [calibre](#).



Figure 2.46 Top to bottom: Browning M2 (.50 BMG), Breda Modello 37 (8 × 59Rb mm), Breda Modello 31 (13.2 × 99 mm) Tula Arms Plant DShKM (12.7 × 108 mm), V.A. Degtyarev Plant KPV (14.5 × 114 mm) [not to scale] (sources: Small Arms Survey; Wikimedia Commons; MJL Militaria; Rosoboronexport).

Cartridge Ammunition Velocities

The muzzle velocity (MV) potential of traditional metallic-cased small- and medium-calibre cartridges is primarily dictated by case capacity. A larger case permits the loading of more propellant, allowing for increased burn and therefore greater pressure, more energy, and ultimately higher MV (notwithstanding other factors including barrel length). As a rule, cartridges for light weapons which are 20 mm or greater in calibre allow for far greater case capacity than small arms cartridges—meaning that a larger calibre correlates closely with higher MV.¹⁰⁹ Muzzle energy is a function of muzzle velocity and projectile weight. As this guide shows, MV is a useful distinguishing factor for various categories of arms and munitions (e.g., in broadly separating Light Weapons from lower velocity Small Arms and higher velocity Heavy Weapons), but is particularly helpful in separating the Types of Light Guns. A key distinction between Light Cannon and Light Grenade Launchers, for example, is their MV—especially as the ammunition for these two Types of weapon may, in some cases, be of similar appearance and functional type.

Subsonic ammunition may be necessitated by the physical limitations of a weapon (as in early or very small handguns, for example) or by design, as in the case of suppressed weapons. The latter may employ ammunition of reduced case capacity, or may simply utilise reduced propellant loads, along with design features such as abbreviated barrel length and ported barrels, to bring velocity below the supersonic threshold (i.e., below the speed of sound—approximately 343 m/s at sea level). This eliminates the supersonic ‘crack’ (as well as mitigating other causes of gunshot noise) (Jenzen-Jones & Ferguson, 2018a; Jenzen-Jones, 2019).

Low-velocity cartridge

A **cartridge** in which the **projectile** develops a **muzzle velocity** of less than 250 m/s.

Medium-velocity cartridge

A **cartridge** in which the **projectile** develops a **muzzle velocity** of at least 250 m/s but less than 800 m/s.

High-velocity cartridge

A **cartridge** in which the **projectile** develops a **muzzle velocity** greater than 800 m/s.

109 There are exceptions to this general rule, such as the relatively low-velocity cartridges fired by grenade launchers.

Light Cannon [Type]

Light Cannon

A light gun intended for direct fire and chambered for high-velocity, medium-calibre ammunition.

Light cannons are guns chambered for a high-velocity, medium-calibre cartridge (those of 20 mm to less than 57 mm in calibre) primarily characterised by relatively long range, high muzzle velocity, and relatively limited curvature of the projectile trajectory within the intended range (Army Materiel Command, 1964, p. 2-1).¹¹⁰ They do not operate on the recoilless principle, and as such must absorb the recoil from firing in some fashion—usually by transmitting this force into the ground via a tripod or other mount. Even though the barrel and action of many light cannons may, in terms of mass, be readily man-portable, the need for some sort of recoil-absorbing mechanism¹¹¹ means some such guns are instead considered crew-portable, and precludes many medium-calibre guns from being classified as Light Weapons.



Figure 2.47 A Nexter P20 (20 × 102 mm) light cannon, mounted on a military vehicle. In recent years, light cannons such as this have been positioned as replacement armaments for .50-calibre machine guns on light tactical vehicles (source: Nexter).

¹¹⁰ The U.S. Army's definition of cannon, in line with historical usage, applies to the barrel and breech of any large-calibre weapon, including mortars. Many European nations regard the term 'cannon' as implying a self-loading design, or 'autocannon'. A representative definition of a cannon is: "a complete assembly which consists of a tube and a breech mechanism with a firing mechanism or base cap and which is a component of a gun, howitzer, or mortar; may include muzzle appendages; the term is generally limited to calibres greater than 1 inch" (McGraw-Hill, 2003).

¹¹¹ I.e., such a recoil mechanism being a critical component.

Light cannon include a small number of so-called ‘anti-materiel rifles’ chambered for a calibre of 20 mm or greater, as well as several [semi-automatic](#) and [automatic](#) weapons typically designed to be employed from a mount or vehicle. These latter weapons are sometimes referred to as ‘autocannon’¹¹² and are often, although not exclusively, employed in an [anti-aircraft role](#). 57 mm calibre is generally understood to constitute the smallest [large-calibre cartridge](#), and thus provides the upper limit for this class (Jenzen-Jones & Schroeder, 2018). Several [cannon](#) models such as the Soviet ZU-23-2, which are sometimes considered light weapons and would otherwise fall into this category, are excluded on the basis of total system weight.



Figure 2.48 Top to bottom: Denel NTW 20 (20 × 82 mm), Truvelo Specialised Manufacturing CMS 20 (20 × 42B mm), Valtion Kivääritehdas L-39 (20 × 138B mm) [not to scale] (sources: Denel, Truvelo Specialised Manufacturing; Royal Armouries).

112 This term is avoided herein to prevent conflation of automatic and semi-automatic weapons of this Type. The distinction between automatic and semi-automatic fire becomes less useful for Heavy Weapons than it is for Small Arms and Light Weapons, as external power becomes commonplace.

Light Recoilless Guns [Type]

Light Recoilless Gun

A light gun of no more than 120 mm in calibre operating on the recoilless principle.

Recoilless guns (sometimes more broadly referred to as ‘recoilless weapons’) are those employing an operating system in which propellant gases or another counter-mass such as a powder or liquid are expelled from the rear of the barrel—typically known as the recoilless principle or ‘Davis principle’. This system equalises (from the user’s point of view) the significant recoil of the relatively large and heavy projectiles these weapons fire and, in the case of those weapons using an additional counter-mass, may also mitigate the back-blast effects when firing from enclosed spaces (Jenzen-Jones, 2015c; Scheiblein, 2020). The reduction in recoil does not come without drawbacks—muzzle velocity is greatly reduced (down to subsonic levels) and as much as three to four times the amount of propellant is necessary as compared to closed-breach guns (Army Materiel Command, 1976, pp. 2–4). Partly because of the reduction in muzzle velocity, many recoilless weapons make use of high explosive anti-tank (HEAT) projectiles to penetrate thick vehicle armour, as the effectiveness of shaped-charge warheads is not affected by a projectile’s speed.



Figure 2.49 Three examples of shoulder-fired light recoilless guns, top to bottom: Dynamit Nobel Panzerfaust 3 (60 mm; 110 mm warhead), Izhmash RPG-7V (40 mm; various warhead sizes, most over-calibre), Saab AT4 (84 mm) [not to scale] (sources: Dynamit Nobel; Small Arms Survey; Saab).

Recoilless guns are also increasingly available with other projectile types including multi-purpose ‘bunker-buster’ types and [high explosive fragmentation \(HE-FRAG\) anti-personnel](#) types to increase their versatility (Jenzen-Jones, Ferguson & Williams, 2018). Smaller models may be carried and fired by one user (typically from the shoulder), whereas larger models are fired from a [mount](#) and [crew-served](#). The term ‘recoilless rifle’, whilst commonplace, strictly applies only to recoilless guns with a [rifled](#) barrel, and many so-called ‘recoilless rifles’ are actually [smoothbore](#) weapons (Jenzen-Jones, 2015c). The broader term ‘recoilless gun’ should generally be preferred. It can be difficult to determine whether some [light weapons](#) are recoilless guns or [rocket launchers](#).¹¹³ Some designs make use of a combination of these principles, as typified by recoilless guns which fire [rocket](#)-assisted projectiles. Common examples of recoilless weapons which fire rocket-assisted projectiles include the Soviet RPG-7, German Panzerfaust 3, and Swedish Carl Gustaf (some rounds).



Figure 2.50 Two common crew-served light recoilless guns, the SPG-9 (73 mm; top) and B-10 (82 mm; bottom), both originally of Soviet design [not to scale] (sources: Small Arms Survey).

¹¹³ The key technical distinction is that “rocket launchers do not propel rockets, which incorporate their own source of propulsion and would still fire successfully if ignited outside their launch tube. In contrast, recoilless weapons have a functional barrel that contributes directly to the acceleration of the fired projectile, which is propelled out of the barrel by the expanding gases generated by burning propellant” (Jenzen-Jones, Ferguson & Williams, 2018, p. 182; Newhouse, 2011).

Light Grenade Launchers *[Type]*

Light Grenade Launcher

A light gun intended predominantly for direct fire and chambered for low-velocity, medium-calibre ammunition.

The term 'grenade' has historically been used to describe a wide variety of different munitions, and is sometimes applied broadly to almost any explosive munition. In the context of modern grenade launchers, the projected 'grenade' is actually the projectile from a low-velocity, medium-calibre cartridge. These cartridges are characterised by having relatively small quantities of propellant relative to the size of the projectile, which results in a much shorter range (but also greatly reduced felt recoil) when compared with a conventional (high-velocity) cartridge design of equivalent calibre (Chinn, 1987, p. 467).



Figure 2.51 Three examples of auxiliary (in this case, underbarrel) light grenade launchers, top to bottom: Izhmash GP-25 (40 mm semi-caseless) fitted to an AK-74 self-loading rifle, Colt Defense M203 (40 × 46SR mm) fitted to an M16A1 self-loading rifle, FN Herstal FN40GL (40 × 46SR mm) fitted to a SCAR-L self-loading rifle [not to scale] (sources: Small Arms Survey; N.R. Jenzen-Jones/ARES).

Grenade launchers are **guns** designed to fire exclusively this sort of low-velocity ammunition. They are found with both **rifled** and **smoothbore barrels** and make use of a variety of **operating systems**, to include both **manually operated** and **self-loading** designs. Confusingly, grenade launcher **ammunition** is generally divided into two categories: ‘low-velocity’ and ‘high-velocity’ cartridges—despite both being of relatively low velocity in the broader sense. These terms are derived from the pressures generated by these cartridges when fired, and largely delineate between **shoulder-fired** grenade launchers (‘low-velocity’) and those which are operated by a **crew** and fired from a **mount** (‘high-velocity’).¹¹⁴ **Crew-served** grenade launchers are most often operated from a ground or vehicle mount have typical maximum ranges of 1,500–2,500 m. They are usually **belt-fed** and **automatic** in operation, giving rise to the terms ‘automatic grenade launcher’ and ‘grenade machine gun’. High-pressure grenade launcher cartridges have significantly longer range, but create too much recoil and firing pressure for practical use in a hand-held weapon. The lower-pressure ammunition is used for both standalone, shoulder-fired grenade launchers and auxiliary grenade launchers, which are mounted on other small arms (typically rifles) (Williams, 2017). Increasingly, so-called ‘medium-velocity’ ammunition is being introduced, primarily with the intent of extending the range of hand-held weapons.

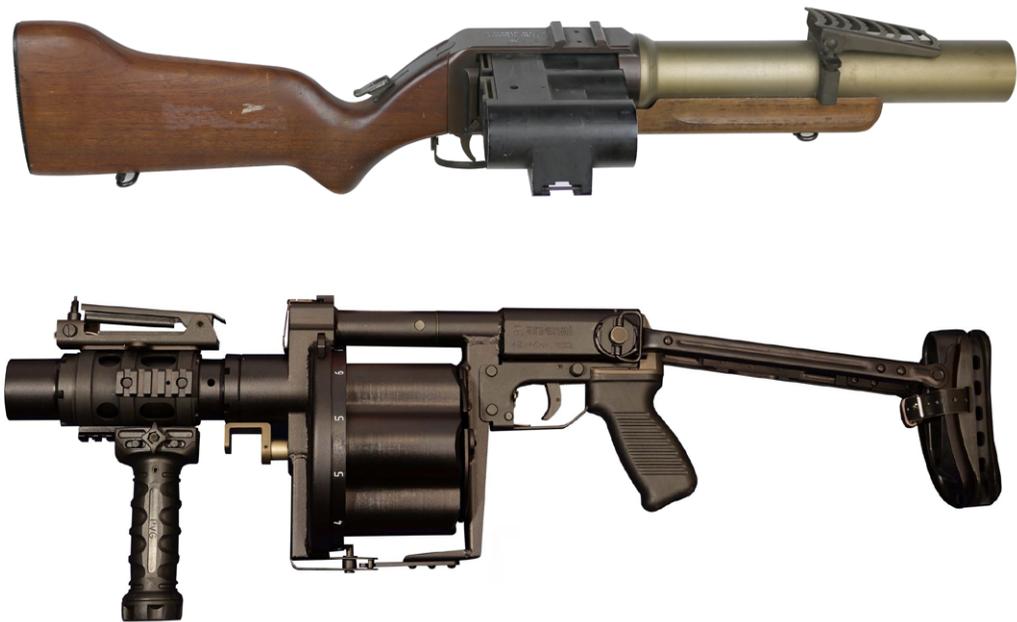


Figure 2.52 Two examples of hand-held light grenade launchers, top to bottom: Springfield Armory T148E1 (40 × 46SR mm), Arsenal MSGL (40 × 46SR mm) [not to scale] (source: N.R. Jenzen-Jones/ARES).

114 See General Dynamics, 2020. It is important to note that these terms do not reflect the broader distinction between low-velocity and high-velocity ammunition used by many armed forces or manufacturers, nor indeed within ARCS (see *Cartridge Ammunition Velocities*, p. 83).

Grenade launchers, like [shotguns](#), are prime candidates for flexible use with alternative projectiles because of their large [bore](#) size. This is particularly true of hand-held models, which are frequently used to fire RCA and other [less-lethal](#) projectiles, as well as other specialist ammunition types. Longer-range ammunition has been introduced in limited quantities and remains under development, and some manufacturers also offer sophisticated fire control systems and [fuzes](#) to achieve an airburst effect (Williams, 2017; Jenzen-Jones, 2015b).



Figure 2.53 Two examples of crew-served light grenade launchers, top to bottom: Zastava Arms M93 (30 × 29B mm), General Dynamics Ordnance & Tactical Systems MK47 MOD0 (40 × 53SR mm) [not to scale]. In this case, both are automatic weapons (sources: Zastava Arms; Australian Department of Defence).

Crew-portable Mortars [Type]

Crew-portable Mortars

A relatively short-barrelled **light gun** designed predominantly for **indirect fire** and firing **low-velocity projectiles** of at least 50 mm in **calibre** but less than 100 mm in calibre.

Light Mortar [Sub-type]

A **crew-portable mortar** firing **projectiles** of less than 70 mm in **calibre**, transported and operated by an individual or a **crew** of no more than three individuals on foot.

Medium Mortar [Sub-type]

A **crew-portable mortar** firing **projectiles** of at least 70 mm in **calibre** but less than 100 mm in calibre.

Modern mortars are a form of light **artillery** consisting of a simple **barrel** (often called the 'tube') and typically incorporating a stabilising baseplate that transmits recoil forces to the supporting surface. Mortars are most commonly **smoothbore**, **muzzle-loading** weapons, although some have **rifled** barrels. Most mortars are intended to deliver **indirect fire** to the target and are restricted in elevation—often only capable of firing at high-angle trajectories (above 45°), meaning that they cannot be used in a **direct-fire** role (Jenzen-Jones, 2015b). Compared with artillery gun barrels, a mortar barrel for a given **calibre** is generally shorter and lighter and allows for greater **windage** (Ryan, 1982). Within a given calibre, the range of the **projectile** and its point of impact can be adjusted by both angling the barrel and, often, by using different sizes or quantities of auxiliary **propellant** charges. Firing in a very high, arcing trajectory, mortars require specific sighting and laying systems.

Generally, the larger the projectile fired by a mortar, the greater the intended combat range and the higher level of organisation at which such weapons are controlled within an armed force. Light mortars (no greater than 70 mm in calibre¹¹⁵) are commonly employed at the section/**squad** level, medium mortars (at least 70 mm but less than 100 mm in calibre)¹¹⁶ are commonly employed at the company level or higher, and heavy mortars (100 mm or greater in calibre) are generally employed

115 It should be noted that there have been some examples of mortars chambered for projectiles of less than 50 mm in calibre, including the Soviet M1939 'spade-mortar' (37 mm), the British 1.57 inch Medium Mortar (40 mm), the Italian Brixia Modelo 35 (45 mm), and the Polish Granatnik wz. 36 (46 mm). All of these are obsolete.

116 The 100 mm limit was established by the Group of Governmental Experts in 1997 (UNGA, 1997) but has since been revised upward to 120 mm by the Small Arms Survey and other groups (Small Arms Survey, 2008, pp. 8–11). ARCS cleaves to the earlier, lower limit in order to better reflect actual battlefield usage (largely dictated by the practicality of the crew numbers and vehicle types necessary to transport and operate larger mortar systems).

at the battalion level or higher (Jenzen-Jones & Paunila, 2017). Some light mortars, often referred to as ‘commando mortars’, are designed to be carried and operated by a single individual on foot (i.e., they are [man-portable](#)).

[Muzzle-loading](#) mortars are loaded with a projectile that is dropped down the barrel, initiating their propellant charge on impact with a fixed [firing pin](#) at the base (‘drop-fired’). Some light mortars (especially ‘commando’ designs) are fitted with a [trigger mechanism](#)—the mortar projectile is loaded into the barrel (sometimes called ‘pre-loading’) and the weapon can then be fired at the desired moment by pulling a [trigger](#) or lever (trigger- or lever-fired).¹¹⁷ This gives the operator a greater amount of control but also limits the range, as fewer auxiliary propellant charges (if any) can be used, lest the trigger assembly be damaged. There are a small number of mortars that do not follow the typical design. [Breech-loading](#) mortars can be employed in the direct-fire role, and ‘silent’ mortars operate on the [captive piston](#) principle, generating almost no [muzzle flash](#) or blast and requiring only a very short barrel. More recent developments include signature (sound, flash, and thermal) reduction systems and [guided](#) mortar projectiles (Williams, 2016; Jenzen-Jones, 2015b).



Figure 2.54 Left to right: SKB No. 4 M1940 (50 mm), PPT Namenska M70C (60 mm)[not to scale] (sources: Rock Island Auction Company; PPT Namenska).

117 Modern examples include the U.S. M224 60 mm Mortar (Department of the Army, 2007, p. 3-1) and the Austrian M6 C-640 Mk1 60mm Commando Mortar (Hirtenberger Defence Systems, 2016).



Figure 2.55 Top to bottom: Royal Ordnance L16 (81 mm), CRI Burevestnik 2B24 Sani (82 mm) [not to scale] (sources: Wikimedia Commons; Rosobornexport).

Light Powered Munition Launchers *[Group]*

Light Powered Munition Launcher

A **light weapon** which provides a **launch platform** and a method of initiating a **powered munition**.

'Light powered munition launcher' is a broad term used to encompass those **light weapons** which serve to provide support for the initial flight orientation of a **powered munition**; a method of initiating its launch; and any applicable ancillary functions, such as **guidance** or control. The two main Types of light powered munition launchers are **light rocket launchers** (firing **unguided, propellant**-burning powered **munitions**) and **light missile launchers** (firing **guided** powered munitions that are often, but not exclusively, **rocket**-propelled). A limited number of unguided powered munitions using a propulsion source other than a rocket motor also exist. Weapons in this Group are capable of engaging a wide range of targets, and are often designed for specific, relatively niche battlefield purposes. **Man-portable air defence systems** (MANPADS), for example, are specifically designed and engineered for the technically challenging task of engaging fast-moving combat aircraft from the ground, within the confines of a **man-portable** package. Very few MANPADS are capable of engaging non-aerial targets (Berman et al., 2017).

Light Rocket Launchers *[Type]*

Light Rocket Launcher

A **light weapon** which provides a **launch platform** and a method of initiating a **rocket**.

Rockets are **unguided**,¹¹⁸ **powered munitions** which carry within themselves a supply of combustible **propellant**, burning it during operation to achieve thrust. The motion of these **munitions** is due to **reaction propulsion** (as opposed to the combustion of propellant within a sealed chamber) (UK MoD, 2013). Weapons launching rockets are almost entirely free of **felt recoil**, as the rocket is not restrained by the **launcher** and all **recoil energy** is directly applied to move the munition forward. Rocket launchers come in a range of sizes, from **handgun**-sized to large **artillery** pieces. Smaller examples may be carried and fired by one operator (typically from the **shoulder**), whereas larger versions are fired from a **mount** and **crew-served**. The specific type of munition being fired can dramatically alter the role of a rocket launcher. Munitions can be designed specifically to **defeat armoured vehicles**, to fragment for **anti-personnel** use, or for other purposes.

¹¹⁸ Rockets with guidance systems are frequently referred to as 'guided missiles', although some entities make the distinction between munitions originally designed to incorporate guidance systems and those adapted for them (akin to the difference between a shotgun fitted with a rifled choke and a 'true' rifle) (Jenzen-Jones, 2015e). For the purposes of ARCS, rockets which are fitted with guidance systems are classified as guided missiles.



Figure 2.56 Top to bottom: Mecar RL-83 Blindicide (Egyptian contract; 83 mm), Talley Industries M72A3 LAW (66 mm), MAS LRAC F1 (89 mm), NPO Bazalt RPG-18 (64 mm) [not to scale] (sources: N.R. Jenzen-Jones/ARES; Small Arms Survey; Zonawar).

Light Guided Missile Launchers *[Type]*

Light Guided Missile Launcher

A **light weapon** which provides a **launch platform** and a method of initiating a **guided missile**.

Guided missiles are **powered munitions** designed to travel above the surface of the earth, the **flight path** of which can be controlled after launch (either by internal and/or external inputs). Most light guided missile launchers can strike their targets precisely, and would be considered **precision guided munitions** (PGMs) (Jenzen-Jones & Shanley, 2021). A complete light guided missile launcher is a **weapon system**, consisting of the **launcher** itself, the missile, and any ancillary elements required for the munition to reach its intended target (e.g., **guidance** and control systems). Generally speaking, light guided missile launchers require either few or no external support elements (larger guided missiles may rely on, for example, external radar systems). As such, they are typically limited to the surface-to-air and surface-to-surface domains. Within recent decades, more and more systems are being developed to operate within multiple domains as technology progresses and manufacturers strive to achieve market superiority. So-called 'loitering munitions' (sometimes called 'loitering missiles') are also a form of guided missile, although the evolving capabilities and use cases for this category of weapon has seen them classified differently by various organisations.

Light guided missile launchers may be broadly divided into two main categories: weapon systems firing **surface-to-surface missiles (SSMs)** and weapon systems firing **surface-to-air missiles (SAMs)**. Most light guided missile launchers firing SSMs use munitions considered to be **anti-tank guided missiles (ATGMs)**,¹¹⁹ whilst most firing SAMs are considered **man-portable air defence systems (MANPADS)**, although the overlap between these makes this an increasingly false dichotomy.¹²⁰ It should be noted that the commonly used term '**anti-tank guided weapon (ATGW)**' comprises a wider category of weapon systems which incorporate other types of guided munitions, such as guided mortar projectiles and guided artillery gun projectiles. Many of these are fired from **heavy weapons**. SAM systems are designed to be carried and employed by one operator (MANPADS) or operated from a mount and/or vehicle by a small crew ('crew-portable air defence systems'; CREWPADS).¹²¹ They consist of a **launch tube** with sighting system; a guided missile, commonly operating on the passive infra-red homing principle (command guidance and laser beam-riding

119 Note that, despite this traditional terminology, modern 'ATGM' include a variety of munitions and often employ dual-purpose anti-tank/anti-personnel warheads (e.g., the MBDA ATGM5, see L&T MBDA, 2020).

120 An early example was the Oerlikon/Martin Marietta 'Air Defense Anti Tank System' (ADATS), adopted by the US military as the MIM-146 ADATS (Nicklas, 2012). Munitions such as the 'BOLIDE' missile for the Saab RBS-70 surface-to-air light guided missile launcher continue this tradition (Saab, 2016; Berman et al., 2017).

121 'Crew-portable air defence system.'

guidance being some alternatives); and, typically, a **gripstock** unit which combines the functions of a **firing grip** and **buttstock**, and contains a power source and ignition system. In many cases the battery, or a combined battery coolant unit (BCU), may be separate from the gripstock (Berman et al., 2017; DIA, n.d.).



Figure 2.57 A Thales UK Lightweight Multiple Launcher – Next Generation (LML-NG) firing a STARStreak high-velocity surface-to-air missile. This type of light guided missile launcher is often considered a ‘crew-portable air defence system’ (CREWPADS) (source: Thales UK).

A guided missile commonly has four key elements: a propulsion system, flight system, guidance system, and warhead. Guided missile propulsion systems can be broadly categorised as liquid propellant, solid propellant, or ‘air breathers’ (Department of the Air Force, 1972, pp. 1–16). Given the small size of light guided missiles, solid propellant rocket motors are the most likely to be encountered. The propulsion system might consist of a single **rocket motor**, or be a more complicated ‘rocket engine’. The flight system consists of the **control surfaces** (fins, ailerons, etc.) and their corresponding control devices. Some munitions, such as the missiles fired by the U.S. M47 Dragon, utilise dedicated rocket motors to make adjustments to their **flight path**. The guidance system may be totally independent within the missile (so-called ‘**fire-and-forget**’; F&F) or it may require direction and guidance from the operator/launcher. Fire-and-forget guidance systems are most common for MANPADS, depending on sensors that detect the signature of their target. The warhead section¹²² will contain the missile’s **payload** as well as one or more **fuzes**.¹²³ Depending on the type of fuzing (contact, proximity, etc.), the fuze may be standalone or integrated with the missile’s guidance system.

¹²² Note that the term ‘warhead’ is used generically, and does not necessarily indicate that a munition’s payload is contained within the nose or forward section (‘head’) of the munition—although this is often the case.

¹²³ In specialist arms and munitions use, the spelling of ‘fuze’ (with a ‘z’) has come to distinguish a more complex mechanical, chemical, or electrical firing device from simple ‘fuses’ (spelled with an ‘s’), which are cord- or tube-like containers filled with deflagrating or detonating materials.



Figure 2.58 Two light guided missile launchers firing surface-to-air missiles, commonly regarded as MANPADS. Top: Mesko PPZR Piorun (72 mm); bottom: KB Mashinostroyeniya 9K32M Strela-2M (72 mm) (sources: Mesko; U.S. Navy).

The two most common [guidance principles](#) for SSM systems are manual command to line-of-sight (MCLOS) and semi-automatic command to line-of-sight (SACLOS). MCLOS guidance requires the operator to manually guide the missile onto target. This method requires a high degree of skill to operate, and generally sees the operator controlling the missile's flight through a magnifying periscope from a fixed position. SACLOS systems only requires the operator to keep the weapon's sighting system trained on the target during the missile's flight, requiring significantly less operator training to achieve proficiency versus an MCLOS system (Fulmer, Jenzen-Jones & Lyamin, 2016; Jenzen-Jones, Ferguson & Williams, 2018). SSM systems with F&F guidance are also available.



Figure 2.59 Three light guided missile launchers firing surface-to-surface missiles, commonly regarded as ATGMs. Left to right: Raytheon M47 Dragon (140 mm), KBP Instrument Design Bureau 9K135 Kornet-E (152 mm), Eurospike SPIKE LR (130 mm) [not to scale] (sources: Wikimedia Commons; Rosoboronexport).

Other Light Weapons [Group]

The 'Other Light Weapons' Group is meant to encompass those [light weapons](#) utilising mechanisms that do not easily fit into those categories used for the most common weapons. [Flamethrowers](#), for example, are not typically understood to fit the definition of a [gun](#), [rocket](#), or [guided missile](#), nor are they commonly used today.

Light Flamethrowers [Type]

Light Flamethrower

A [man-portable](#) device which ejects a flammable substance (a fuel) towards the target without the use of a delivery [munition](#).

Flamethrowers are relatively simple weapons which combine a tank of [incendiary](#) fuel with a tank of compressed gas and an ignition mechanism. First used in the First World War and operated until the 1980s by the United States military,¹²⁴ flamethrowers are a devastating close-range weapon capable of killing by direct application of heat, or by asphyxiation and carbon monoxide poisoning in an enclosed space (Hobson, 2010). The flammable substance used in military flamethrowers is typically a petroleum-based fuel, either thickened or un-thickened. A thickened or gelled fuel (sometimes referred to colloquially as 'napalm'¹²⁵) has a greater range than liquid fuel, and will tend to stick to objects and burn much longer than liquid fuel.¹²⁶



Figure 2.60 A Soviet LPO-50 flamethrower (source: Royal Armouries).

124 Most other nations have also removed these weapons from inventory today.

125 The term 'napalm' refers to a specific gelled fuel mixture developed in the United States, with a thickening agent primarily constituted of co-precipitated aluminium salts of naphthenic and palmitic acids, hence 'na-palm' (Neer, 2015).

126 Most flame projectors used for agricultural purposes (weed burning, for example) use flammable compressed gasses (primarily propane) as their fuel, rather than a pressurised liquid or gel fuel.

The method of ejecting the flamethrower's contents is usually achieved through the use of high-pressure gases such as nitrogen or compressed air, but [single-shot](#) weapons may utilise some type of propellant cartridge. The fuel is ignited by ignition cartridges or a pilot flame placed in front of the weapon's nozzle. Some rarer examples of flamethrowers used white phosphorous as a fuel, which is pyrophoric—it self-ignites upon contact with air—and does not require a separate ignition source (NDRC, 1946, pp. 97–101).

It is important to note that some weapons that use incendiary or thermobaric munitions are identified as 'flamethrowers' by the parties which employ them. One example is the Russian 93 mm RPO-Z, part of the broader range of RPO munitions. Under ARCS, this would be classified as a [light recoilless weapon](#), as it operates on the [recoilless principle](#), using a [projectile](#) to deliver an incendiary payload to the target.

Light Projectors *[Type]*

Light Projector

A [light weapon](#) which propels a [projectile](#) by way of stored mechanical energy.



Figure 2.61 Two light projectors. *left: a Leach–Gamage Catapult, which used elastic rubber tubing to store mechanical energy. Right: a West Spring Gun, which employed several coiled springs to achieve a similar effect [not to scale] (sources: Imperial War Museum; Australian War Memorial).*

Projectors use stored mechanical energy—often stored in a spring or similar elastic mechanism—to propel a [projectile](#) toward a target. In simple terms, most projectors are similar in form and function to catapults, slingshots, or crossbows. Projectors are rare in modern conflicts, but are not unheard of. Several devices employing this principle were used during the First World War, including the British Leach-Gamage Trench Catapult and the German *Wurfmaschine* (Credland, 2010). More recently, non-state actors in Syria and other conflicts have employed slingshots and catapults to propel improvised [hand grenades](#) and other [explosive](#) or [incendiary munitions](#) (ARES, n.d.). It is important to note that the word ‘projector’ was long used for [grenade launchers](#) and [mortars](#), but that use has largely abated today (Ferguson, 2015a).



Figure 2.62 An improvised light projector, used to project craft-produced high explosive munitions in Syria (source: AFP).

SALW-adjacent Items not Classified by ARCS

N.R. Jenzen-Jones & Jonathan Ferguson

Other Items

With any system of classification there will be outliers, some of which have been mentioned in preceding chapters. Notwithstanding the definition of ‘gun’ used within ARCS (see also *Firearms & Guns*, p. 34), the word is popularly used to describe a range of devices which are not significant in the context of conflict or interpersonal violence and are therefore not encompassed by ARCS. It is important to specify some of the more common outlying categories for the avoidance of confusion. There are also numerous examples of gun-like objects (notably, various sorts of replica firearm) that are likewise not directly covered by ARCS but that readers should be aware of due to their similarity to weapons that *are* included.

Drill & Dummy Weapons

Drill weapon

A replica weapon specifically designed to simulate the form of a weapon or weapon system in order to enable or enhance training exercises.

Dummy weapon

An object presenting the general appearance of a lethal-purpose weapon, in order to enable or enhance training exercises.

The terms ‘drill’ and ‘dummy’ are sometimes used interchangeably. A drill weapon allows individuals and crews to practice basic actions, movements, and procedures without inflicting wear and damage on more expensive, ‘real’ (lethal or less-lethal) weapons and without the risk of negligent discharges. Some drill weapons, particularly small arms, are in fact out-of-service models that have been deactivated in some fashion. A distinction is sometimes made between drill and dummy weapons, in that drill arms are specifically used for the practice of formal drill movements and must therefore be functionally identical to their live-fire counterparts, other than the ability to discharge a shot (e.g., British Army ‘Drill Purpose’ or ‘DP’ variants of live firearms). Dummy weapons, on the other hand, are used for generic training purposes and need only resemble a given model in basic dimensions, weight, and appearance (for example, the ‘rubber duck’ polymer replicas utilised by the U.S. military).¹²⁷ Drill weapons may also be used by civilians for training skills such as firearms manipulation.

¹²⁷ Note that, in the context of cartridges, the meanings are essentially reversed. ‘Drill rounds’ are typically visually identifiable as inert cartridges by their lack of a primer, colour, and/or the shape of the case. Dummy rounds, on the other hand, are intended to look like live rounds, but lack propellant and use an inert (or fired) primer (Jenzen-Jones, 2018, p. 141).



Figure 2.63 A selection of drill and dummy weapons intended variously for military, law enforcement, and/or civilian users [not to scale] (sources: SFTD; ASMC; ASP; Cowan's Auctions; IMA).

Blank-firing Weapons

Blank-firing weapon

A firearm-shaped object which is designed to generate the report of a firearm but not fire a projectile.

Although often called ‘signal pistols’ or ‘starter pistols’—based on their historical application in starting sporting event (races, typically)—blank-firing weapons (also called ‘blank firers’) are today more often marketed for self-defence purposes. They are intended to frighten or ward off an intruder or attacker in jurisdictions or circumstances in which a **lethal** weapon is not available. Because these devices often resemble true firearms and are sometimes similarly manufactured, they are sometimes converted into lethal weapons with varying degrees of success (King, 2015). In simple terms, the closer a given blank-firer is in terms of materials and engineering to an ‘original lethal-purpose’ firearm, the easier the conversion is likely to be. Some legal jurisdictions mandate specific design features intended to dissuade or prevent ready conversion (Ferguson & William, 2014; Ferguson & Jenzen-Jones, 2017).¹²⁸



Figure 2.64 Two blank-firing weapons of handgun form [not to scale] (sources: EKOL; Allcock's).

¹²⁸ A UK-legal blank-firing BBM Glock replica, for example, vents firing gases from the top of its chamber, whereas the variant sold on the European continent vents through the muzzle and generally functions like a conventional (blowback-operated) self-loading pistol.

Once successfully converted to [firearms](#), blank-firing weapons may then be classified in the same manner as any other [small arm](#), under the appropriate category within ARCS. For example, a Lord T822 forward-venting blank-firer may or not be legally considered a ‘firearm’ (depending on jurisdiction), but it is not subject to classification under ARCS due to its lack of lethal function. If its barrel obstructions are mechanically removed (or its barrel entirely replaced) such that it can be used with lethal-purpose cartridges, however, it would be classified under the ‘[Handguns](#)’ Group and ‘[Self-loading Pistols](#)’ Type categories. Similarly, a lethal-purpose firearm loaded with [blank cartridges](#) or fitted with an accessory such as a [blank-firing adaptor \(BFA\)](#) should not be classified as a blank-firing weapon if the weapon itself remains capable of [chambering](#) and firing lethal ammunition.



Figure 2.65 A variety of blank-firing weapons [not to scale] (sources: Russ Guns; Rohm; North Weapon).

Air Weapons

Air weapon

A **barrelled** weapon shooting potentially **lethal projectiles** by means of compressed gas.

Air weapons are typically lethal-purpose (albeit many are only marginally so) weapons used for target shooting, vermin control, and small game hunting. Propellant gases are either atmospheric gas or carbon dioxide (CO₂), and, in parallel with **firearms**, a range of **operating systems** are employed. Although commonly referred to as ‘air rifles’, not all air weapons have **rifled barrels**. The terms ‘air gun’ (or ‘airgun’) and ‘pellet gun’ or ‘pellet rifle’ are also common. The most common **calibres** are .177 and .22 inch. Another sort of air weapon, so-called ‘arrow-rifles’ or ‘airbows’, require less air pressure to achieve lethality as they share with conventional bows the use of a relatively heavy projectile with high sectional density and, typically, a cutting point. Depending upon the legal jurisdiction, some or all such air weapons may be classified as firearms, but technically speaking they are not—as they do not use the combustion of **propellant** in order to propel their projectile. There is considerable overlap here with **replica firearms** (see below), and a given gun-shaped object may simultaneously be both an air weapon and a replica firearm.¹²⁹

Note that paintball markers, ‘BB’ guns, ‘gel blasters’, and ‘airsoft’ guns (see p. 107) are all essentially non-**destructive** variants of air weapon. Indeed, CO₂-powered air pistols are direct derivatives of airsoft technology, and some replica or pseudo-replica paintball markers also draw from the airsoft industry. However, these devices are designed for recreational use, and for most intents and purposes are not regarded as firearms or even weapons.



Figure 2.66 Two airbows, a Benjamin AIRBOW (top) and an Umarex Air Javelin (bottom) [not to scale] (sources: Benjamin; Umarex).

¹²⁹ Depending upon jurisdiction, an air weapon that may or may not also be a replica may additionally also be deemed a firearm for legal purposes, as in the case of ‘Section 1’ air weapons in the UK.



Figure 2.67 Four air guns, top to bottom: Gamo Boxer; FX Airguns Maverick; Air Arms S410; Umarex UX Patrol (sources: Gamo; FX Airguns; Uttings; Umarex).

Replica Firearms

Replica firearm

A gun-shaped object intended to closely resemble a **firearm**.

Replica or ‘imitation’ firearms may be wholly inert, partially functional (e.g., moving slide and magazine), or have non-**destructive** effects (e.g., an airsoft weapon), but are set apart by their close resemblance to a **lethal-purpose firearm**. Replica firearms are distinct from ‘reproduction’ firearms, which are fully functional, firing copies of original historical firearms.¹³⁰ Versions of replica firearms which ‘fire’ include **blank-firing weapons** and, notably, **air weapons** firing small metal or plastic pellets. These are popularly called ‘BB’ guns, after the spherical pellets they shoot. These are either metallic, usually steel, shot (often 4.5 mm/.177 in; known as ‘ball bearings’, or ‘BBs’, due to their origin or in the case of ‘airsoft’ (sometimes called ‘soft-air’), 6–8 mm plastic pellets intended for use against other players in the pastime of the same name. These two overlapping types of devices, powered by compressed gas, are today the most common forms of replica firearm. Neither of these are designed to be used as weapons, although in specific situations they could cause injury (primarily if a person is hit in the eye). They may also easily be mistaken for real firearms by the public or by law enforcement, and so are sometimes legally restricted in some way.¹³¹ They are typically made from comparatively weak materials such as plastic or cheap metal alloys, both for economic reasons and to prevent ready conversion to fire lethal-purpose **ammunition**. Replica firearms are primarily used recreationally, either for private interest (including collection), or for use in mock combat games and sports. There is considerable overlap between air weapons and replica guns, and different jurisdictions legislate for them in different ways.



Figure 2.68 *Two non-firing replica handguns [not to scale] (sources: Replica Firearms; Wolf Armouries).*

¹³⁰ For classification purposes, reproduction firearms are often no different than the originals which they copy, although some will be made with operating systems or other features distinct from the original weapon they copy (e.g., semi-automatic variants of historic military weapons capable of automatic fire). As such, whilst reproduction firearms should be classified as any other firearm under ARCS, they will not necessarily be classified in the same manner as the weapons they copy.

¹³¹ In several countries, a brightly coloured barrel plug is mandatory, for example.



Figure 2.69 Two replica rifles, both of the ‘airsoft’ type [not to scale] (sources: Patrol Base UK).

Directed-energy Weapons

Directed-energy weapon

A weapon achieving **less-lethal** or **lethal** effects by means of **directed energy**.

Directed-energy weapons (DEWs), like **flamethrowers**, do not employ **munitions** to achieve their intended effects upon target. These may be **lethal** or **less-lethal**, but are primarily thermal effects caused by the agitation of molecules by means of laser light, microwave energy, or high-energy particles (particle beams).¹³² By the 1990s, large vehicle- or installation-mounted systems were capable of using directed energy to achieve **destructive** effects at a distance (Rogoway, 2020a). **Man-portable** systems of similar power have remained firmly in the realm of science fiction. As technology has progressed, however, hand-held systems with less-lethal or minor destructive effects have become viable and have even been fielded. At the time of writing, their useful destructive effects are limited to blinding of electro-optical sensors or the human eye. This latter usage was prohibited by the 1995 international ‘Protocol on Blinding Laser Weapons (Protocol IV to the 1980 Convention)’ (Human Rights Watch, 2000) and the use of lasers for blinding purposes has been very rarely observed in conflict zones thus far (ARES, n.d.).¹³³ Many directed-energy weapons are advertised as being ‘less-lethal’ or ‘non-lethal’. Terms such as ‘temporary blindness’, for example, are used to describe the intended effects of some laser ‘dazzler’ weapons. At some

132 The word ‘laser’ being derived from the acronym ‘Light Amplification by Stimulated Emission of Radiation.’

133 At the time of writing, China is the only known user of blinding—rather than dazzling—lasers. See Cronin & Neuhard, 2020.

point in the future, it is likely that DEWs capable of manifesting substantially lethal effects will be available in both [small arms](#) and [light weapons](#) formats. The main limiting factors are the very high electrical energy requirements and the current lack of tactical imperative that would drive innovation in this direction (conventional SALW are broadly seen as adequate for current needs). Should a breakthrough be achieved, however, size and weight constraints are likely to make DEWs classified as Light Weapons under ARCS the first such weapons to become available.

Less-lethal Weapons

Less-lethal weapon

A weapon designed to incapacitate and/or gain the compliance of a target without killing or seriously wounding.

Less-lethal weapons are primarily used in a law enforcement context—by both police and military users—in order to subdue individual criminal suspects or to control unruly crowds.¹³⁴ Although many are based on conventional [small arms](#), other less-lethal weapons include those powered by compressed gas,¹³⁵ those that directly disperse an irritant or incapacitant (most often a ‘riot control agent’, or RCA), electro-muscular incapacitation devices (the best-known being those of Taser make), and [directed-energy weapons](#). While some models of small arms (primarily [shotguns](#)) and [light weapons](#) (primarily [light grenade launchers](#)) can fire less-lethal [munitions](#) such as rubber bullets, beanbag rounds, tear gas, and electro-muscular incapacitation rounds, some weapons are specifically made for less-[lethal](#) use. Only these weapons may reasonably be regarded as truly ‘less-lethal’ (i.e., no ‘lethal-purpose’ weapon that also fires less-lethal ammunition can be classified as a ‘less-lethal weapon’). In some cases, purpose-built less-lethal weapons are developed to prevent accidental use of lethal [arms](#) in a crowd-control situation, or in order to maximize the effectiveness of a particular less-lethal munition which may not readily adapt to use in a standard [gun](#). Notably, no rifle or shotgun can accommodate ammunition of 37 mm or 40 mm calibre, necessitating either a dedicated less-lethal weapon or (potentially) a lethal-purpose grenade launcher (respectively).

Historically, less-lethal weapons have also been described as ‘nonlethal’, but today the terms ‘less-lethal’ or ‘less-than lethal’ are generally preferred. While the intent of these weapons is not to kill, many may be capable of causing death or serious injury through improper use or sheer misfortune. Less-lethal munitions may strike their target in sensitive areas such as the eyes, or trigger allergic reaction, induce cardiac trauma, or have other potentially lethal effects.

134 Varieties of less-lethal weapon are also used to subdue animals for husbandry, veterinary, or zoological purposes but, unlike lethal weapons designed primarily for use against animals, these are not typically used against human targets and as such are not addressed herein.

135 See, for example, the FN Herstal FN 303 CO₂-powered less-lethal weapon, a purpose-designed device that leverages paintball gun technology (.68 calibre projectiles and a refillable compressed air tank), firing a range of different projectiles (including marker and irritant types) from a 15-round rotary magazine (FN Herstal, 2021).



Figure 2.70 An electro-muscular incapacitation device (TASER X26) and a riot control agent (RCA) dispenser (SABRE OC and CS spray) [not to scale] (sources: Wikimedia Commons; Security Equipment Corporation).



Figure 2.71 Less-lethal weapons capable of firing 'kinetic impact' projectiles, subduing subjects through pain/shock, and sometimes with additional effects such as RCA [not to scale] (sources: Barney's; FNH USA; N.R. Jenzen-Jones/ARES; Rosoboronexport).

Flare Guns

Flare gun

A **firearm** primarily intended to fire illuminating **munitions** and not intended to kill or wound.

The dedicated flare gun, sometimes called a ‘signal gun’, is closely related to **firearms**. Whilst flares may be projected from a range of weapons, the flare gun is typically a **manually operated single-shot handgun** specifically designed to project an illumination **munition** for rescue or signalling purposes. For safety and legal reasons, they are not normally capable of chambering a **lethal-purpose cartridge**, setting them apart from lethal-purpose single-shot handguns, **shot** pistols, **light grenade launchers**, and so on. No longer common in a military context, they are still in use in maritime, wilderness survival, and other contexts involving remote or wide-open spaces with poor communications. Flare guns are sometimes regarded as a subset of **less-lethal weapon**, but as they are not designed for use against living targets, this is not a particularly helpful classification.



Figure 2.72 A selection of flare guns intended for both military and civilian use [not to scale] (sources: Collector’s Firearms; Rock Island Auction Company; CIL; Arundel Militaria).

PART TWO



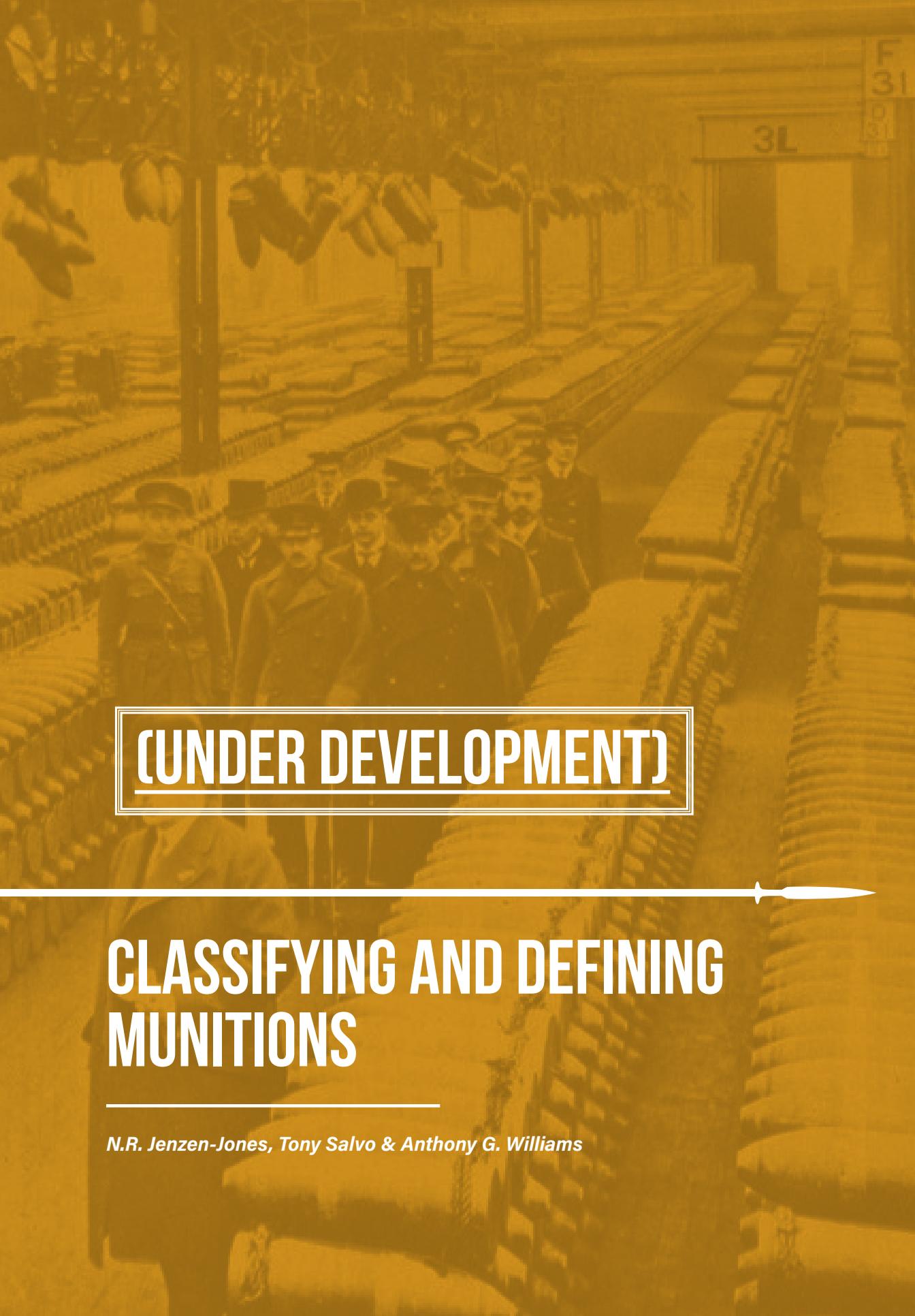
(UNDER DEVELOPMENT)

CLASSIFYING AND DEFINING HEAVY WEAPONS

N.R. Jenzen-Jones & Tony Salvo



PART THREE



(UNDER DEVELOPMENT)

CLASSIFYING AND DEFINING MUNITIONS

N.R. Jenzen-Jones, Tony Salvo & Anthony G. Williams

Glossary

This glossary presents brief explanations of some of the important terms used within ARCS. ARES is continuing to update the terms herein, and is also developing further glossary entries and definitions. The most recent public versions of these are being made available at:

www.armamentresearch.com/glossary.

Where possible, please refer to the most current web version in the first instance.

Note that not all of the definitions contained within this glossary have been subject to the same rigorous development and testing as the 'core' ARCS definitions (stylised in the body of this report in coloured boxes). In some cases, definitions in the glossary have been sourced from previous publications by ARES and other organisations. Where applicable, a citation indicating this effect has been provided. Note that these may have been lightly adapted for the purposes of this glossary, and should not be taken as verbatim representations of the source definition.

Accessories: Items which may be fitted to [small arms](#), [light weapons](#), or [heavy weapons](#) to provide some ancillary capability, but which are not [critical components](#).

Accuracy: The measure of [mean point of impact](#) (MPI) deviation from the desired MPI (i.e., the proximity of a fired [munition](#) to its intended target) (Dullum, 2017). See also: '[Precision](#)'.

Action: The mechanical means by which a [gun](#)'s [operating cycle](#) is carried out, whether manually or by one of several [systems of operation](#) powered by the [chemical energy](#) stored in the weapon's [ammunition](#). Hence 'bolt-action', 'lever-action', etc.

Air weapon: A [barrelled](#) weapon shooting potentially [lethal projectiles](#) by means of compressed gas.

Ammunition: [Munitions](#) which are fired by a weapon or [weapon system](#). A single unit is a '[round](#)'. Colloquial shortened form: 'ammo'.

Anti-aircraft mount: A mechanism holding a weapon which allows for 360-degree rotation, elevation adjustment up to the vertical (or nearly so), and rapid traverse.

Anti-personnel (APERS): A user, weapon, or [munition](#) role concerned primarily with the attack of human targets.

Anti-tank (AT): A user, weapon, or [munition](#) role concerned with the attack of armoured vehicles, especially heavily armoured vehicles such as tanks. Sometimes 'anti-vehicle (AV)'.

Anti-tank guided weapon: A weapon or [weapon system](#) firing [guided munitions](#) primarily intended to defeat armoured vehicles. Includes [missiles](#), [mortar projectiles](#), and [artillery gun projectiles](#).

Anti-tank guided missile: A [guided missile](#) primarily intended to defeat armoured vehicles.

Arm:

1. (*Noun*) Shortened form of '[armament](#)'.
2. (*Verb*) To make a weapon or [weapon system](#) ready to fire. Often necessitating the disengagement of a [safety mechanism](#).
3. (*Verb*) To make a [munition](#) ready to function, such as by the removal or disengagement of a safety mechanism, or the alignment of the components of a [fuze](#). May be effected by internal or external forces.

Armament: A weapon (often abbreviated to 'arm').

Artillery: Weapons designed to engage targets at the limits of, or beyond, a user's line-of-sight (i.e., those weapons capable of long-range fire, typically [indirect fire](#)).

Automatic (action): A weapon [action](#) that will fire continuously as long as the [firing mechanism](#) is activated, until the [feed device](#) is empty. Not to be confused with '[semi-automatic](#)' (including the popular but improper usage of 'automatic' where 'semi-automatic' is meant).

Automatic rifle:

1. (*Noun*) A [rifle](#) capable of [automatic](#) fire.
2. (*Proper noun, U.S.*) A [light machine gun fed](#) from a box [magazine](#).
3. (*Proper noun, UK*) A [select-fire](#) infantry rifle.

Auxiliary weapon: A secondary weapon fitted to another (primary) weapon (e.g., an [under-barrel grenade launcher](#)).

Ball (cartridge): In modern usage, [full metal jacket](#) ammunition. The term derives from archaic [firearms](#) which primarily fired lead spheres—either 'ball' or smaller 'shot'.

Barrel: The primary pressure-bearing component of a [projectile](#) weapon that contains and directs the projectile. See also: '[Chamber](#)'.

Belt-fed (weapon): A weapon using a [feed device](#) consisting of a flexible metal, polymer, or cloth strip of [ammunition](#), typically holding at least 100 [rounds](#). This belt may be continuous or consist of individual links which separate when [cartridges](#) (or fired [cartridge cases](#)) are removed.

Bipod: A pair of stabilising legs attached to a weapon to steady it when resting against the ground or another solid surface or object.

Birdshot: A [shotgun cartridge load](#) consisting of numerous small pieces of [shot](#), primarily intended for shooting birds (hence the name) and other small game animals. Most birdshot is between 1 and 4 mm in diameter.

Black powder: A [low explosive](#) composed of a mixture of sulphur, carbon, and potassium nitrate (saltpetre). Commonly used as a [propellant](#) for [small arms](#), [light weapons](#), and [heavy weapons](#) until the advent of [smokeless powder](#) in the late-19th century. Also 'gunpowder'.

Blank (cartridge): A cartridge with no lethal [projectile](#), used to create noise (e.g., for training purposes, or to scare away wildlife) or to generate pressure for launching another projectile (e.g., a rifle grenade or distress flare). Blank cartridges designed specifically for launching rifle grenades are sometimes called ‘grenade blanks’.

Blank-firing adaptor (BFA): A specialised [muzzle device](#) which restricts the [bore](#) of a gun and thus increases gas pressure, allowing a [self-loading](#) weapon to [cycle](#) reliably when used with [blank cartridges](#). See also: ‘[Operating cycle](#)’.

Blank-firing weapon: A [firearm](#)-shaped object which is designed to generate the [report](#) of a firearm but not fire a [projectile](#).

Blowback: An [operating system](#) in which the [bolt](#) is not locked to the [breach](#) on firing, being held in place only by its own inertia and the return spring. Only suitable for relatively low-pressure [ammunition](#), such as [handgun cartridges](#) or ammunition for [grenade launchers](#).

Body (British English): See ‘[Receiver](#)’.

Bolt: The component of a [gun](#) that closes and (together with a [cartridge case](#)) seals the breach. In some guns, especially [light weapons](#) and [heavy weapons](#), a form of bolt is instead known as a ‘breachblock’. See also: ‘[Breach](#)’; ‘[Bolt carrier](#)’.

Bolt action: A type of [manually operated firearm action](#) in which the weapon is [cycled](#) by manipulating a handle affixed to its [bolt](#). The most common variants are turn-bolt and straight-pull actions.

Bolt carrier: A [gun](#) component which ‘carries’ the [bolt](#) back and forth within the [receiver](#) in order to engage with locking recesses in the receiver or [barrel](#) extension.

Bore:

1. The inside of a [gun barrel](#).
2. Shortened form of ‘bore diameter’, historically measured in inches (e.g., a ‘.410 bore’ shotgun features a barrel with a bore diameter of .410 of an inch).
3. (*British English*) Often used interchangeably with [gauge](#), although this use is not recommended.

Box magazine: See ‘[Magazine](#)’.

Break-open (action): A type of [manually operated gun action](#) in which the weapon is [reloaded](#) by disconnecting the [barrel](#) from the [breach](#), normally by pivoting the barrel downwards or to one side relative to the [receiver](#).

Breach: the rear opening of a [barrel](#) (opposite the [muzzle](#)), usually containing the [chamber](#) and closed by the [bolt](#).

Buckshot: A [shotgun cartridge load](#) consisting of several pieces of [shot](#), each of approximately .33 inches in diameter, originally intended for deer hunting (hence the name) but now also used for sports shooting and [anti-personnel](#) purposes.

Burst-fire mechanism: A mechanism which restricts an otherwise [automatic](#) weapon to firing a fixed number of [rounds](#) (typically three) each time the [firing mechanism](#) is activated.

Bullet: A [projectile](#) fired from a [firearm](#). Projectiles of 20 mm or larger in diameter are often referred to simply as 'projectiles'. See also: '[Calibre](#)'; '[Shell](#)'.

Bullpup (firearm): A [firearm](#) in which the [firing grip](#) is located in front of the [breach](#) (Ferguson, 2020).

Butt: See '[Buttstock](#)'.

Buttstock: The part of a weapon which is braced against the user's body (typically the shoulder) when firing, and which may form part of a larger [stock](#). Also 'butt', 'stock', or 'shoulder stock'.

Calibre:

1. Strictly, the diameter of the [bore](#) of a [gun](#) (thus synonymous with a common usage of 'bore') or the [projectile](#) itself. Practically, the diameter of bore and projectile often differ noticeably, especially in [rifled](#) weapons. Calibre may thus be determined by measuring the bore between either the [lands](#) or [grooves](#), or may be expressed as an average of both diameters. For design and marketing purposes, even an arbitrary figure may be used (Jenzen-Jones, 2019).

2. In the context of [artillery guns](#), a measurement of [barrel](#) length with respect to the bore diameter. The effective length of the barrel is divided by the bore diameter to give a figure in calibres, which is often expressed alongside the bore diameter (U.S. Navy, 1957, p. 81). For example, a '5"/40' gun has a 5-inch bore and barrel length of 40 calibres, or 200 inches ($5 \times 40 = 200$).

3. Sometimes used synonymously with [cartridge designation](#) (e.g.,

'7.62 mm NATO calibre') or for a collective type of ammunition (e.g., '[intermediate-calibre cartridge](#)').

Cannon:

1. A [gun](#) chambered for [high-velocity ammunition](#) of at least 20 mm in [calibre](#), designed for [direct fire](#). [Self-loading](#) cannons are sometimes called 'autocannon'.

2. (*Historical*) An [artillery gun](#) primarily firing large [shot](#).

Captive piston: An [operating system](#) in which [propellant](#) gases drive a piston up a cylinder and impart velocity to the projectile whilst remaining trapped within the sealed cylinder. As a result, there is no [muzzle flash](#) or blast, and firing the weapon is extremely quiet. Used by some [light mortars](#), low-velocity [grenade launchers](#), and [pistols](#) intended for covert operations.

Carbine:

1. (*Historical*) A short [rifle](#) intended for use by military personnel in non-infantry (e.g., cavalry, artillery) roles.

2. (*Contemporary*) Any short rifle, especially where a longer version is also (or was previously) in service. This use is not recommended.

Cartridge: A single, self-contained unit of [ammunition](#) consisting of a [cartridge case](#), [primer](#), [propellant](#), and one or more [projectiles](#). In [caseless cartridges](#), the cartridge case may be absent, the cartridge's propellant fulfilling some of the same functions.

Cartridge case: The portion of a [cartridge](#) that encloses the [propellant](#), [projectile\(s\)](#), and [primer](#). In many weapons, the cartridge case also helps to provide rearward [obturation](#). Absent from [caseless cartridges](#).

Cartridge designation: An expression of the nominal [calibre](#) of a [cartridge's projectile](#) and the [cartridge case length](#) (e.g., '5.56 × 45 mm') and/or a descriptive term (e.g., '5.56 NATO' or '5.56 × 45 mm NATO'). Cartridges expressed in Imperial (or U.S. Customary) units most often use the combination of a cartridge's calibre and a descriptive term (e.g., '.338 Lapua Magnum'), whilst those expressed in SI (metric) units most often use the calibre and cartridge case length, and optionally include a descriptive term (e.g., 12.7 × 108 mm) (Jenzen-Jones, 2019).

Cartridge headspace (CHS): The distance from the face of the closed [breach](#) of a [firearm](#) to the surface in the [chamber](#) on which the [cartridge case](#) seats. This point usually corresponds to either the rim or shoulder of the cartridge case, and varies depending upon the geometry of the [cartridge](#) being chambered (Ferguson, 2015b).

Caseless cartridge: A type of [cartridge](#) which lacks a [cartridge case](#). Instead, the [projectile](#) is partially or entirely embedded ('telescoped') into a block of [propellant](#). In weapons firing caseless cartridges, rearward [obturation](#) must be provided for solely by the design of the weapon itself. Distinct from [separate-loading](#) ammunition.

Chamber:

1. (*Noun*) The component of a [gun](#) designed to accept a [round](#) of [ammunition](#) and contain the pressure generated on firing. Often, but not always, formed from the [breach](#) of the [barrel](#).
2. (*Verb*) To position a [round](#) of [ammunition](#) within the [chamber](#) [noun] of a [firearm](#).

Chambered (for): An indication of which [cartridge\(s\)](#) a [gun](#) (usually a [firearm](#)) is designed to [chamber](#). Usually expressed in terms of [cartridge designation](#) (e.g., 'the rifle was chambered for the 7.62 × 39 mm cartridge').

Charger clip: A [clip](#) used to load a [magazine](#), whether internal to the weapon or detachable. Also '[stripper clip](#)'.

Chemical energy: A form of potential energy which is stored in the bonds of a substance and released when it undergoes a chemical reaction.

Clip: A [feed device](#) lacking its own feeding spring (as opposed to a [magazine](#)). May be of [charger clip](#) or [en bloc clip](#) type.

Cock [*verb*]: The [action](#) of making a [firearm](#) ready for firing by moving to the rear and against spring tension a [hammer](#) or [striker](#) that is then released by a [trigger](#). Note that the etymologically related noun 'cock' refers to that part of a [flintlock](#) firearm that holds the flint.

Coilgun: A weapon utilising electromagnetic coils through which a [projectile](#) is accelerated by precisely timed changes in magnetic flux. See also: '[Railgun](#)'.

Control hand: The hand employed by the user of a weapon to activate its [firing mechanism](#). In most cases, this is the user's dominant hand (e.g., the right hand, in the case of a right-handed user). See also: '[Support hand](#)'.

Control surfaces: Aerodynamic surfaces which can be moved to control the path of a [munition](#) in flight.

Crew: Two or more persons assigned to operate (and often transport) a weapon or [weapon system](#).

Crew-portable (weapon): A weapon which can be transported and operated by no more than five people on foot. Where the weapon is broken down into several loads for transport, it is sometimes referred to as a ‘man-packable’ weapon. See also: ‘[Crew-served](#)’.

Crew-portable mortar: A relatively short-barrelled [light gun](#) designed predominantly for [indirect fire](#) and firing [low-velocity projectiles](#) of at least 50 mm in [calibre](#) but less than 100 mm in calibre. See also ‘[Mortar](#)’; ‘[Mortar projectile](#)’.

Crew-served (weapon): A weapon typically operated by a [crew](#). Most often used to describe [small arms](#) or [light weapons](#), but applicable to many [heavy weapons](#).

Critical components: Those parts of a weapon or [weapon system](#) that are necessary for the weapon to function as intended. In the case of [guns](#), these are often [pressure-bearing components](#).

Cycle [verb]: The act of completing a weapon’s [operating cycle](#), either manually or automatically.

Cylinder: The rotating cluster of [chambers](#) comprising the integral feed device of a [revolver](#).

Damage mechanism: See ‘[Effect mechanism](#)’.

Delayed blowback:

1. A variety of [blowback operating system](#) in which the opening of the [bolt](#) is mechanically delayed, allowing [chamber](#) pressure to

drop to a level deemed safe for the user and the structural integrity of the [gun](#). The [action](#) remains fully locked until peak gas pressures have subsided.

2. (*Colloquially*) Synonymous with ‘[retarded blowback](#)’. This use is not recommended.

Deringer: See ‘[Derringer](#)’.

Derringer: A form of compact [single-shot](#) or (later) multi-barrelled [handgun](#) derived from a particular style of single-shot, [muzzle-loading pistol](#) invented by Henry Deringer in the 1820s. Despite the spelling of the inventor’s last name, ‘derringer’ remains the most common form today. Also ‘Deringer’.

Designate (a target) [verb]: To identify and assign a target for engagement. In modern usage, the term often refers to the process of selecting a target for a weapon system (whether one’s own or that used by friendly personnel) using electronic, electro-optical, or other technological means.

Designated marksman rifle (DMR): A medium-range, accurised self-loading rifle for use at the [squad](#) or section level.

Destructive (weapon; munition): A weapon or [munition](#) that is capable of damaging materiel, vehicles, or structures. In almost every case, a ‘destructive’ weapon is capable of [lethal](#) effects if used in the [anti-personnel](#) role.

Directed energy: An umbrella term covering technologies that relate to the production of a beam of concentrated electromagnetic energy or atomic or subatomic particles (U.S. DoD, 2020, p. 64).

Directed-energy weapon: A weapon achieving [less-lethal](#) or [lethal](#) effects by means of [directed energy](#).

Direct fire: Fire aimed at targets within the operator's line-of-sight, where the weapon can be aimed directly at the target (Dullum et al., 2017).

Double-action (weapon): A weapon (typically a [revolver](#)) that can either be manually [cocked](#) (and then fired using the [trigger](#)—i.e., [single-action](#) operation) or both cocked and fired simply by pulling the trigger.

Double-action only (DAO) (weapon): A weapon (typically a [revolver](#)) that can be [cocked](#) and fired simply by pulling the [trigger](#), but which lacks a [hammer](#) spur and internal mechanism to allow for [single-action](#) fire.

Drill weapon: A [replica weapon](#) specifically designed to simulate the form of a weapon or [weapon system](#) in order to enable or enhance training exercises.

Dummy weapon: An object presenting the general appearance of a [lethal](#)-purpose weapon, in order to enable or enhance training exercises.

Effect mechanism: The means by which a weapon or [munition](#) achieves its desired effect on a target (e.g., blast, kinetic, thermal, chemical, electromagnetic). When referring to [lethal](#) arms or munitions, the term 'damage mechanism' is common.

Ejection: The phase of a [gun's](#) [operating cycle](#) in which the extracted [cartridge case](#) is thrown clear of the weapon. See also: '[Extraction](#)'.

En bloc clip: A type of [clip](#) that remains within or attached to the weapon until

empty, at which point it is manually removed, drops free, or is ejected.

Explosive:

1. (*Noun*) A substance (or a mixture of substances) which, under external influence, is capable of rapidly releasing energy at such a temperature and pressure as to be [destructive](#) (NATO Standardization Agency, 2002, p. C-28; 2013, p. 2-E-7). Further divided into [high explosives](#) and [low explosives](#).

2. (*Munition; weapon*) A [munition](#) with an [explosive](#) [noun] (typically [high explosive](#)) [payload](#), or a weapon which fires munitions with an explosive payload.

Extraction: The phase of a [gun's](#) [operating cycle](#) in which a fired [cartridge case](#) is mechanically removed from the [chamber](#). See also: '[Ejection](#)'.

Feed:

1. (*Verb*) To move a [round](#) of [ammunition](#) from a [feed device](#) to the point at which it is [chambered](#). See also: '[Operating cycle](#)'.

2. (*Noun*) The assembly or assemblies which feed [verb] ammunition to a weapon. Sometimes understood to include the feed device.

Feed device: An [ammunition](#) storage and loading device. Also 'feeding device'.

Feeding device: See '[Feed device](#)'.

Felt recoil: The portion of a weapon's [recoil](#) that is felt by the firer, assessed in terms of relative recoil energy (only a portion of which is actually perceived by the firer). Also 'perceived recoil'.

Fire-and-forget (F&F) (guidance):

A [guidance system](#) which requires no further input once the user has [designated](#) a target and launched a [munition](#). In some cases, the user may then fire at another target as the previous munition continues its attack.

Firearm: A [man-portable gun](#) (i.e., a gun falling into the [Small Arms](#) or, occasionally, [Light Weapons](#) classes under ARCS). In historical usage (*ca.* 14th–17th centuries), the word was instead synonymous with the hierarchically superior term ‘gun’ (i.e., it referred collectively to guns now regarded separately as either small arms, light weapons, or [heavy weapons](#)).

Firing cycle: See ‘[Operating cycle](#)’.

Firing grip: The portion of a weapon that is grasped in the [control hand](#). Typically co-located with the [trigger](#).

Firing mechanism: The assembly within a weapon responsible for initiation of loaded/chambered [ammunition](#). In a [firearm](#), typically a [trigger mechanism](#).

Firing pin: A component of a firearm’s action which contacts the [primer](#) in a [round](#) of [ammunition](#), firing it. Within a [hammer](#)-fired [firing mechanism](#), the firing pin is first struck by the hammer.

Flare gun: A [firearm](#) primarily intended to fire illuminating [munitions](#) and not intended to kill or wound.

Flight path: The trajectory of a [munition](#) through the air.

Flintlock (firearm): A [firearm](#) with a [firing mechanism](#) which utilises the interaction of a hardened steel component and piece of siliceous stone (typically flint) to create sparks for the ignition of a priming charge.

Frame: See ‘[Receiver](#)’.

Full metal jacket (FMJ) (projectile): A [projectile](#) that is covered from tip to base with an outer envelope of thin metal. In some cases, the base may also be covered.

Full-power rifle cartridge: A [rifle cartridge](#) generating more than 2,600 J of [muzzle energy](#) when fired from a [barrel](#) having a minimum length of 400 mm (Jenzen-Jones, 2019).

Fully automatic: Redundant (if commonplace) term. See: ‘[Automatic](#)’.

Functional type: A descriptor conveying information about the purpose of a [munition](#), typically by describing its primary role (e.g., [anti-personnel](#)), [payload](#) (e.g., [high explosive](#)) and/or effect mechanism (e.g., blast). Usually preceding a classifying term (e.g., ‘tracer cartridge’, ‘fragmentation grenade’).

Furniture: Those components fitted to a weapon to enable its carriage and control by the operator. May include a unitary [stock](#) or [gripstock](#), or separate [buttstock](#), handguard and (often) [pistol grip](#).

Fuse: A cord- or tube-like container filled with deflagrating ([low explosive](#)) or detonating ([high explosive](#)) materials (Picatinny Arsenal, 1974). The word fuse will, in many cases, be preceded by additional information such as ‘time’, ‘cannon’, or ‘blasting’ to clarify its function. See also: ‘[Fuze](#)’.

Fuze: A mechanism with explosive components designed to initiate a train of fire or detonation in a [munition](#) by a mechanical, chemical, or electrical action (e.g., hydrostatic pressure, impact, inertia, mechanical time delay). The vast majority of fuzes will also

feature some type of safing/arming mechanism. Especially in an EOD context, fuzes will often be referred to by their method of initiation and arming (e.g., ‘a setback-armed, impact-initiated fuze’). See also: [‘Fuze’](#).

Gas-operated (gun): A [self-loading gun action](#) in which [propellant](#) gas is tapped (typically from the barrel) to operate the action.

Gauge: The number of lead [balls](#) of a weapon’s [bore](#) diameter which would be required to make a total weight of one pound. Generally applied only to [shotguns](#). Often used, incorrectly, as synonymous with ‘bore’. See also: [‘Calibre’](#).

Grenade:

1. Shortened form of ‘hand grenade’ or [‘rifle grenade’](#).
2. *(Historical)* A [hand grenade](#).
3. Shortened form of [‘grenade launcher cartridge’](#). This use is not recommended.
4. *(Colloquially)* Any [explosive munition](#). This use is not recommended.

Grenade blank: See [‘Blank’](#).

Gripstock: A detachable device which incorporates a [firing grip](#) and [buttstock](#) in a single unit. Simple versions, such as those which enable an [under-barrel grenade launcher](#) to be used separate to a host weapon, typically have few mechanical and no electronic components. More elaborate examples, such as those used on [MANPADS](#), may include [firing mechanisms](#), [optical sights](#), fire control systems, etc.

Grooves: The recessed portions of the [bore](#) in a [rifled barrel](#) (i.e., the inverse of the [lands](#)). See also: [‘Rifling’](#).

Guided missile: A [powered guided munition](#) designed to travel above the surface of the earth.

Guided munition: A [munition](#) capable of altering its [flight path](#) in response to internal or external inputs. See also: [‘Guided missile’](#).

Guided weapon:

1. A [weapon system](#) firing a [guided munition](#).
2. A [guided munition](#).

Guidance principle: The means by which a [guided munition](#) is steered to its target, most commonly manual command to line-of-sight (MCLOS), semi-automatic command to line-of-sight (SACLOS), or a variety of [fire-and-forget \(F&F\) guidance](#).

Guidance system: The portion of a [guided munition](#) responsible for steering the [munition](#) its target (often by controlling the manipulation of [control surfaces](#)) in response to internal or external inputs.

Gun:

1. A weapon which uses the combustion of a [propellant](#) to generate high-pressure gas in a sealed [chamber](#) in order to accelerate a [projectile](#) in a controlled manner.
2. *(Experimentally)* A weapon which uses electromagnetic force in order to accelerate a [projectile](#) in a controlled manner (e.g., [railgun](#), [coilgun](#)).

Gunpowder:

1. **Black powder**.
2. (*Colloquially*) **Propellant**. This use is not recommended.

Hammer: A component responsible for impacting the **primer** in a **cartridge** or **munition**, firing the weapon. The hammer may operate in an arc or in linear fashion (a 'linear hammer') and may impact the primer either directly or via an intermediate **firing pin**. See also: '**Striker**'.

Hand grenade: A relatively small **munition** which contains a **fuze** and is designed to be thrown by an individual towards a target.

Handgun: A **firearm** which is grasped by placing both the **control hand** and **support hand** around the **pistol grip**, and which may be readily fired with one hand. Also 'pistol'.

Handgun-calibre cartridge: See '**Handgun cartridge**'.

Handgun cartridge: A **small-calibre cartridge** typically fired from **handguns** with a **rifled bore**, and generally having an overall length of less than 60 mm (Jenzen-Jones, 2019). Also 'handgun-calibre cartridge'; 'pistol-calibre cartridge'.

Heavy machine gun: A **crew-served rifled light gun** primarily intended for **automatic** fire and **chambered** for a **cartridge** of more than 8 mm but less than 20 mm in **calibre**.

Heavy weapon: A weapon or **weapon system** which must be transported and operated by a **crew** of no fewer than six individuals on foot, is dependent on a vehicle or aircraft to operate, or weighs more than 300 kg when in a firing configuration.

High explosive:

1. (*Noun*) An **explosive** material that detonates, rather than deflagrates or burns, when used under normal conditions (i.e., it can support a detonation wave by itself regardless of confinement) (U.S. Army Ordnance School, 1962; Thurman, 2017). See also: '**Low explosive**'.
2. (*Munition*) A **munition** with a high explosive [noun] **payload**.

High explosive anti-tank (HEAT) (munition): A **munition** primarily designed to defeat armoured vehicles, and which carries one or more shaped charges as a **payload**.

High explosive fragmentation (HE-FRAG) (munition): A **munition** which utilises a **high explosive** payload to rapidly disperse fragmentation (either pre-formed or formed from the rupturing body of the munition).

High-velocity cartridge: A **cartridge** in which the **projectile** develops a **muzzle velocity** greater than 800 m/s.

Incendiary (weapon; munition): A weapon or **munition** which utilises thermal effects as its primary **effect mechanism**.

Indirect fire:

1. Fire directed at targets which may or may not be within the operator's line-of-sight, where the weapon is not aimed directly at the target (i.e., fire which uses the trajectory of a **projectile** and/or the **guidance** characteristics of a **munition** to strike targets) (Dullum et al., 2017). See also: '**Direct fire**'.
2. (Uncommon) Fire delivered in circumstances where the target is visible from the **weapon system**,

but where the direct ‘vision link’ between the operator and target is not used for aiming (Ryan, 1982).

Intermediate-calibre (cartridge):

1. Shorthand for [intermediate-calibre rifle cartridge](#).
2. A [cartridge](#) intermediate in [calibre](#) between two broad groupings of cartridges (e.g., between [handgun cartridges](#) and [rifle cartridges](#), or between cartridges typically associated with general-purpose machine guns and those typically associated with [heavy machine guns](#)). This use is non-specific and not recommended without additional qualifiers.

Intermediate-calibre rifle cartridge: A [rifle cartridge](#) generating between 1,300 and 2,600 J of [muzzle energy](#) when fired from a [barrel](#) having a minimum length of 400 mm (Jenzen-Jones, 2019). See also: ‘[Intermediate-calibre \(cartridge\)](#)’.

Lands: The raised portions of the [bore](#) in a [rifled barrel](#) (i.e., the inverse of the [grooves](#)). See also: ‘[Rifling](#)’.

Large-calibre cartridge: A [cartridge](#) greater than 57 mm in [calibre](#).

Launch platform: A weapon and/or [mount](#) which provides static support and initial flight orientation for a [powered munition](#) (Ostendorf, 1985, p. 19-13). Can range from a crude metal frame to part of a complex [weapon system](#). May be called a ‘launch tube’, ‘launch rail’, etc. depending on its form factor.

Launcher: A weapon which provides a [launch platform](#) and a method of initiation for a [munition](#). This term is best applied to weapons firing [powered](#)

[munitions](#), but also forms part of the term ‘[grenade launcher](#)’ and is sometimes applied to other [guns](#) firing [low-velocity cartridges](#).

Less-lethal (weapon; munition): A weapon or [munition](#) designed to incapacitate and/or gain the compliance of a human target without killing or seriously wounding.

Lethal (weapon; munition): A weapon capable of killing or seriously wounding a human target. Some [arms](#) or [munitions](#) intended primarily to wound are referred to as ‘incapacitating’.

Lever action: A type of [manually operated firearm action](#) in which the weapon is [cycled](#) by manipulating a lever, usually operated by the [control hand](#).

Light cannon: A [light gun](#) intended for [direct fire](#) and [chambered](#) for [high-velocity](#), [medium-calibre ammunition](#). See also ‘[Cannon](#)’.

Light flamethrower: A [man-portable](#) device which ejects a flammable substance (a fuel) towards the target without the use of a delivery [munition](#).

Light grenade launcher: A [light gun](#) intended predominantly for [direct fire](#) and chambered for [low-velocity](#), [medium-calibre ammunition](#).

Light guided missile launcher: A [light weapon](#) which provides a [launch platform](#) and a method of initiating a [guided missile](#).

Light gun: A [light weapon](#) which uses the combustion of a [propellant](#) to generate high-pressure gas in a sealed chamber in order to accelerate a [projectile](#) in a controlled manner.

Light mortar: A [crew-portable mortar](#)

firing [projectiles](#) of less than 70 mm in [calibre](#), transported and operated by a [crew](#) of no more than three individuals on foot. See also '[Mortar](#)'; '[Mortar projectile](#)'.

Light powered munition launcher: A [light weapon](#) which provides a [launch platform](#) and a method of initiating a [powered munition](#).

Light projector: A [light weapon](#) which propels a [projectile](#) by way of stored mechanical energy.

Light recoilless gun: A [light gun](#) of no more than 120 mm in [calibre](#) operating on the [recoilless principle](#).

Light rocket launcher: A [light weapon](#) which provides a [launch platform](#) and a method of initiating a [rocket](#).

Light weapon: A weapon or [weapon system](#) which may be transported (with its [ammunition](#) and any [critical components](#)) and operated by a [crew](#) of no more than five individuals on foot, weighs 300 kg or less (excluding ammunition) in a firing configuration, and does not meet the definition of a [small arm](#).

Load:

1. (*Verb*) To introduce [ammunition](#) into the [operating system](#) of a weapon.
2. (*Noun*) A given combination of [propellant](#) and [projectile](#) within a [cartridge](#), which may be varied to achieve differing effects within cartridges of the same [calibre](#). A change in load may result in a change in [functional type](#), but the term is usually applied to variations within one functional type. Also 'loading'.

3. (*Noun*) Shortened form of 'combat load'. The total ammunition load carried by a soldier, vehicle, [squad](#), etc. (e.g., 'the tank carried a 55-round load').

Loading: See '[Load](#)'.

Long gun: A [firearm](#) which is grasped by placing the [control hand](#) and [support hand](#) in different locations, and which is typically fitted with a [buttstock](#) intended to be braced against the user's shoulder when fired.

Low explosive: An [explosive](#) material that deflagrates or burns, rather than detonates, when used under normal conditions (U.S. Army Ordnance School, 1962). See also: '[High explosive](#)'.

Low-velocity cartridge: A [cartridge](#) in which the [projectile](#) develops a [muzzle velocity](#) of less than 250 m/s.

Magazine: A [feed device](#) which can hold multiple [cartridges](#) and uses an outer shell or frame containing a spring to move cartridges towards a weapon's [action](#).

Man-portable (weapon): A weapon which can be transported and operated by a single individual on foot. See also: '[Crew-portable \(weapon\)](#)'.

Man-portable air defence system (MANPADS): A [man-portable light guided missile launcher](#) firing a [surface-to-air missile](#).

Man-portable machine gun: A [self-loading long gun](#) chambered for a [rifle cartridge](#) and primarily intended for [automatic](#) fire from a [bipod](#) or [mount](#).

Manually operated (firearm): A [firearm](#) making use of an [operating system](#) which relies on the user, rather than the [chemical energy](#) contained within a [cartridge](#), to [extract](#) and [eject](#) fired [cartridge cases](#) and load new cartridges.

Manually operated rifle: A [rifle](#) with an [operating system](#) which relies on the user, rather than the [chemical energy](#) contained within a [cartridge](#), to [extract](#) and [eject](#) fired [cartridge cases](#) and load new cartridges.

Manually operated shotgun: A [shotgun](#) with an [operating system](#) which relies on the user, rather than the [chemical energy](#) contained within a [cartridge](#), to [extract](#) and [eject](#) fired [cartridge cases](#) and load new cartridges.

Mean point of impact (MPI): The average impact position of a number of fired [rounds](#) (Dullum, 2017, p. 60).

Medium-calibre cartridge: A [cartridge](#) of more than 20 mm but less than 57 mm in [calibre](#).

Medium mortar: A [crew-portable mortar](#) firing [projectiles](#) of at least 70 mm in [calibre](#) but less than 100 mm in calibre. See also '[Mortar](#)'; '[Mortar projectile](#)'.

Medium-velocity cartridge: A [cartridge](#) in which the [projectile](#) develops a [muzzle velocity](#) of at least 250 m/s but less than 800 m/s.

Minute of angle: A measurement of angle over distance used to assess the [precision](#) of a firearm.

Missile:

1. Shortened form of '[guided missile](#)'.
2. (*Ballistics*) Any object which is propelled or projected toward a target.

Mortar:

1. A relatively short-barrelled [gun](#) designed predominantly for [indirect fire](#) and firing [low-velocity projectiles](#).
2. (*Colloquial*) Shortened form of '[mortar projectile](#)' or 'mortar bomb'. This use is not recommended.

Mortar bomb: See '[Mortar projectile](#)'.

Mortar projectile: A relatively low-velocity [projectile](#) designed specifically to be fired by a [mortar](#). Also 'mortar bomb', although this use is not recommended.

Mount: A device to which a weapon is fitted in order to stabilise it for sustained, mobile, and/or long-range use. Also 'mounting'.

Mounting: See '[Mount](#)'.

Munition: An expendable item which is designed to achieve operational effects by means of an [effect mechanism](#), and which travels from a source (e.g., individual weapon, vehicle-integrated weapon, etc.), via a method of delivery (e.g., emplaced by hand, fired from a [gun](#), etc.), to a target or target area.

Muzzle: The end of a [gun barrel](#) through which [projectiles](#) exit.

Muzzle device: Any component or assembly attached to the [muzzle](#) of a [gun](#) to achieve a desired effect, such as mitigation of sound and/or flash of combusting gases (flash suppressor, flash hider, or sound suppressor) or reduction in felt recoil and/or muzzle rise on firing (muzzle brake, compensator).

Muzzle energy: The energy generated by a given [cartridge](#) as measured at or near the [muzzle](#) of the [firearm](#). Typically expressed in Joules (J).

Muzzle flash: The visible light emitted from the [muzzle](#) of a weapon when it is fired. Often attenuated by the use of a specialised [muzzle device](#).

Muzzle-loading:

1. (*Weapon*) Any weapon which is loaded from the [muzzle](#), rather than the [breach](#).
2. (*Firearm*) A [firearm](#) which does not use self-contained [cartridges](#), instead requiring the [separate loading](#) of [gunpowder](#) and [projectile\(s\)](#) from the muzzle end of the weapon.

Muzzle velocity: The velocity attained by a given [projectile](#) as measured at or near the [muzzle](#) of a weapon. Typically expressed in terms of metres per second (m/s).

Non-rifled (barrel): See '[Smoothbore](#)'.

Obturation: The sealing of a weapon's [chamber](#) against the escape of [propellant](#) gases. In [firearms](#), the chamber itself, as well as the body of the [cartridge case](#), effects obturation forward of the chamber, while rearward obturation is typically effected by the base of the cartridge case and the firearm's [bolt](#). In [munitions](#) fired

by some [light weapons](#) and [heavy weapons](#), a dedicated obturator may instead be used.

Operating cycle: The sequence of events that takes place within a weapon to facilitate repeated fire, whether operated by internal or external forces. In [firearms](#), each [cartridge](#) progresses through an eight-step cycle of *feed-chamber-lock-fire-unlock-extract-eject-cock*. That is, a cartridge is moved from the [feed device](#) (or manually loaded) into the gun's [chamber](#), the [bolt](#) is locked, the cartridge is fired, the bolt is unlocked, and the cartridge is then [extracted](#) from the chamber and [ejected](#) from the gun. Simultaneously, the firearm is (re)[cocked](#) for the next shot. Also 'firing cycle'.

Operating rod: The part of a [gas-operated firearm](#) connecting the gas piston to the [bolt](#), bolt assembly, or [bolt carrier group](#).

Operating system: The arrangement of mechanisms that effect a weapon's [operating cycle](#).

Optical sight: An aiming device which puts the aiming mark(s) on a single focal plane using one or more lenses. May be magnifying or non-magnifying.

Ordnance:

1. Military materiel, including combat weapons of all kinds, [ammunition](#) and equipment for their use, vehicles, and repair tools and machinery.
2. [Munitions](#).

Pack animal: Domesticated livestock used to transport supplies or equipment, such as horses, mules, donkeys, camels, elephants, oxen, and llamas.

Payload: The contents and/or components with which a [munition](#) achieves its intended operational effect(s) upon functioning.

Pistol:

1. A [handgun](#).
2. Shortened form of '[self-loading pistol](#)'. In American English, 'pistol' has come to refer specifically to a self-loading pistol, to the arbitrary exclusion of the [revolver](#). The term 'handgun' is preferred to avoid confusion.

Pistol-calibre cartridge: See '[Handgun cartridge](#)'.

Pistol grip: A [firing grip](#) (often part of a weapon's [furniture](#)) shaped like that of a traditional [handgun](#) and typically intended for use by the user's [control hand](#).

Powered munition: A [munition](#) which, after being fired, uses an on-board propulsion method (e.g., a [rocket motor](#)) to maintain or adjust its rate of travel.

Precision: the measure of the measure of MPI consistency or 'dispersion' (e.g., a gun's ability to repeatedly make accurate shots on the same target) (Dullum, 2017). See also: '[Accuracy](#)'.

Precision guided munitions (PGMs): [Munitions](#), both [powered](#) and unpowered, which can alter their flight paths to strike a target with a high degree of [precision](#) (Jenzen-Jones & Shanley, 2021).

Pressure-bearing components: Those parts of a [gun](#) that contain the pressure generated by firing a [cartridge](#). In many legal jurisdictions, these components are specifically regulated.

Primer: A small initiating element contained in the head of a [cartridge case](#), which ignites the main [propellant](#) charge within the body of the cartridge case when initiated. Most often an [explosive](#) charge, but sometimes functioning via plasma or another principle. Also 'primer cap'.

Projectile: An object initially projected by an applied exterior force and continuing in motion by virtue of its own inertia, such as a [bullet](#) or [hand grenade](#). Smaller projectiles (those fired from [firearms](#)) are often known as 'bullets', whilst certain larger projectiles are sometimes referred to as '[shells](#)'.

Propellant:

1. The main charge for a [round](#) of [ammunition](#) that burns to convert [chemical energy](#) into motive force for one or more [projectiles](#). See also: '[Gunpowder](#)'; '[Smokeless powder](#)'.
2. Combustible material that is burned to provide thrust in a [rocket motor](#).

Pump action: A type of [manually operated small arm](#) or [light weapon action](#) in which the weapon is [cycled](#) by manipulating a handgrip, usually grasped by the [support hand](#), in a linear fashion. Also 'slide action'.

Railgun: A weapon utilising parallel electromagnetic rails to accelerate a [projectile](#) by way of the Lorentz force. See also '[Coilgun](#)'.

Reaction propulsion: The means by which potential energy stored in a [rocket](#) is released as recoil energy to achieve forward motion.

Receiver: The body of a projectile weapon (usually a [firearm](#)), which maintains [critical components](#) in their correct positions. Sometimes breaking into separate parts, often referred to as the ‘upper receiver’ and ‘lower receiver’. Also ‘body’; ‘frame’ (pistols).

Recoil: The rearward force exerted by a [gun](#) in reaction to the forward motion of the [projectile](#) and [propellant](#) gas on firing, in accordance with Newton’s third law. See also: ‘[Felt recoil](#)’.

Recoilless (principle): A [gun](#) design in which [propellant](#) gases (or another counter-mass, such as a powder or liquid) are expelled from the rear of the weapon’s [barrel](#) at the time a projectile is fired. The forward momentum of the projectile is effectively balanced by the rearward momentum of the counter-mass, mitigating [felt recoil](#) (Jenzen-Jones, 2015c).

Repeating (firearm): A [firearm](#) in which the number of [cartridges](#) held in the weapon is greater than the number of [barrels](#), one or more cartridges are held elsewhere than the firing [chamber](#), and more than one shot can be fired before the weapon needs to be [reloaded](#).

Replica firearm: A gun-shaped object intended to closely resemble a [firearm](#).

Report: The loud noise generated by firing most [guns](#).

Retarded blowback: A variety of [blowback operating system](#) in which the opening of the [bolt](#) is mechanically retarded, allowing [chamber](#) pressure to drop to a level deemed safe for the user and the structural integrity of the [gun](#). The [action](#) begins to move rearward immediately after a [cartridge](#) is fired. Often conflated with [delayed blowback](#).

Revolver: A [manually operated handgun](#) with a fixed [barrel](#) and a rotating cylinder containing multiple parallel [chambers](#).

Revolving (action):

1. A [manually operated action](#) used with [small arms](#) and [light weapons](#) which features a fixed [barrel](#) and a rotating [cylinder](#) containing multiple parallel [chambers](#), in which the weapon is [cycled](#) by operating the [trigger](#), [hammer](#), or other component, typically using the [control hand](#). May be [single-action](#), [double-action](#), or [double-action-only](#) weapons.
2. An [automatic action](#) used with [light weapons](#) and [heavy weapons](#) which features a fixed [barrel](#) and a rotating [cylinder](#) containing multiple parallel [chambers](#). Most often externally powered (e.g., by an electric motor), but may be [gas operated](#).

Rifle: A [long gun](#) with a [rifled bore](#), primarily intended to fire individual bore-diameter [projectiles](#) (‘[bullets](#)’).

Rifle cartridge: A [small-calibre cartridge](#) typically fired from [long guns](#) with a [rifled bore](#), and generally having an overall length of 45 mm or greater (Jenzen-Jones, 2019). Also ‘rifle-calibre cartridge’; ‘rifle and machine gun cartridges’.

Rifle grenade: A relatively small [munition](#) which contains a [fuze](#) and is designed to be projected from the [muzzle](#) of a [firearm](#)—with or without the use of an adaptor—by the motive force generated by firing a [small-calibre cartridge](#) (either a [ball cartridge](#) or a [grenade blank](#)).

Rifled (barrel): A [barrel](#) with [rifling](#).

Rifling: A pattern of helical [grooves](#) in the [bore](#) of a [barrel](#) which are designed to impart spin to a fired [projectile](#). This rotation provides gyroscopic stability to the projectile, increasing [accuracy](#) and [precision](#), and ensuring the projectile flies point-first toward the target. In some cases, projectile rotation is achieved by the use of a barrel with a polygonal cross-section.

Rocket: A [powered munition](#) designed to travel above the surface of the earth, which cannot alter its [flight path](#) once in flight.

Rocket motor: A [reaction propulsion](#) system which derives its thrust from the ejection of hot gases generated by the burning of [propellant](#) (Department of the Air Force, 1972, pp. 3-30). The term 'rocket motor' usually refers to a simple, unitary solid propellant rocket, specifically the section containing the propellant, nozzle/venturi, and igniter(s). More complex systems may be referred to as 'rocket engines'.

Round: A complete unit of [ammunition](#). Some ammunition is self-contained (e.g., modern [small-calibre cartridges](#)), whilst other ammunition is [separate loading](#). In the case of separate-loading ammunition, a round comprises all of the necessary components to fire the [munition](#) as intended.

Safety: See '[Safety mechanism](#)'.

Safety mechanism: The assembly within a weapon that serves to engage and disengage one or more of the weapon's safety measures (e.g., by blocking or unblocking the [firing pin](#)). Shortened form: 'safety'.

Section (Commonwealth): See: '[Squad](#)'.

Selective fire: A [firing mechanism](#) which enables the operator to switch between [semi-automatic](#) and [automatic](#) (and/or burst) fire.

Self-loading firearm: A [firearm](#) which make use of the [chemical energy](#) stored in a [cartridge](#) to [cycle](#) the weapon's [action](#), [extracting](#), and [ejecting](#) the [cartridge case](#) immediately after firing, and [chambering](#) a new cartridge from the weapon's [magazine](#).

Self-loading pistol: A handgun which makes use of the [chemical energy](#) stored in a [cartridge](#) to [cycle](#) the weapon's [action](#), [extracting](#), and [ejecting](#) the [cartridge case](#) immediately after firing, and [chambering](#) a new cartridge from the weapon's [magazine](#).

Self-loading rifle: A [rifle](#) that makes use of the [chemical energy](#) stored in a [cartridge](#) to [cycle](#) the weapon's [action](#), [extracting](#), and [ejecting](#) the [cartridge case](#) immediately after firing, and [chambering](#) a new cartridge from the weapon's [magazine](#).

Self-loading shotgun: A [shotgun](#) that makes use of the [chemical energy](#) stored in a [cartridge](#) to [cycle](#) the weapon's [action](#), [extracting](#), and [ejecting](#) the [cartridge case](#) immediately after firing, and [chambering](#) a new cartridge from the weapon's [magazine](#).

Semi-automatic (action): A [self-loading](#) action which is capable of firing only one shot each time the [firing mechanism](#) is activated.

Separate-loading (ammunition): [Ammunition](#) in which two or more components are loaded into a weapon separately (e.g., a [muzzle-loading firearm](#) where a measure of [propellant](#) is loaded before a [projectile](#)). See also: '[Cartridge](#)'; '[Round](#)'.

Shell:

1. A [medium-calibre](#) or [large-calibre projectile](#) containing an [explosive](#) payload. Informally, also applied to a complete [cartridge](#) loaded with such a projectile. The term 'projectile' is generally preferred.
2. (*U.S. English*) Shortened form of 'shotshell' (i.e., a [shotgun cartridge](#)). This use is not recommended.
3. (*U.S. English*) A [cartridge case](#). This use is not recommended.

Shot:

1. One or more spherical [projectiles](#), typically used in [small arms ammunition](#) intended for [smoothbore barrels](#) (hence '[shotgun](#)'). See also: '[Buckshot](#)'; '[Birdshot](#)'.
2. A single discharge of one or more [rounds](#) of [ammunition](#) from any weapon.

Shot column: A grouping of [shot](#), typically fired by a [shotgun](#), as it leaves the [muzzle](#) of a weapon and travels toward its target.

Shotgun: A [smoothbore long gun](#), primarily intended to fire multiple [projectiles](#) of less than bore diameter ('[shot](#)').

Shotgun cartridge: A low-pressure, relatively large-[bore cartridge](#) designed for use in a [shotgun](#) and often containing multiple [projectiles](#) ('[shot](#)') (Jenzen-Jones, 2019). Also 'shotshell'.

Shotshell: See '[Shotgun cartridge](#)'.

Shoulder-fired: [Man-portable](#) weapons that are typically fired from the shoulder, either resting in the 'pouch' of the shoulder (for weapons with a [buttstock](#),

such as a [shotgun](#)) or resting on top of the shoulder (for weapons generating minimal [felt recoil](#), such as a [light rocket launcher](#)). See also: '[Crew-served](#)'.

Shoulder stock: See '[Buttstock](#)'.

Single-action (weapon): A weapon (typically a [revolver](#)) that must be manually [cocked](#) for firing.

Single-shot (weapon): A weapon capable of firing only a single shot before it must be [reloaded](#).

Slide action: See '[Pump action](#)'.

Slug: A single [projectile](#) for use with a [shotgun](#) (as opposed to the multiple projectiles contained in most [shotgun cartridges](#)). Single shotgun projectiles of a spherical shape are sometimes still referred to as '[ball](#)'.

Small arm: A [firearm](#) of less than 20 mm in [calibre](#).

Small-calibre cartridge: A [cartridge](#) of less than 20 mm in [calibre](#).

Small-calibre, high-velocity (SCHV) (cartridge): A [cartridge](#) of less than 6 mm in [calibre](#), which achieves a high [muzzle velocity](#) relative to other cartridges of a similar overall length. See also: '[Small-calibre, high-velocity \(SCHV\) handgun cartridge](#)'; '[Small-calibre, high-velocity \(SCHV\) rifle cartridge](#)'.

Small-calibre, high-velocity (SCHV) handgun cartridge: A [handgun cartridge](#) of less than 6 mm in [calibre](#) which achieves a [muzzle velocity](#) of at least 600 m/s when fired from a [barrel](#) having a minimum length of 100 mm (Jenzen-Jones, 2019). See also: '[Small-calibre, high-velocity \(cartridge\)](#)'.

Small-calibre, high-velocity (SCHV) rifle cartridge: An [intermediate-calibre cartridge](#) of less than 6 mm in [calibre](#) which achieves a [muzzle velocity](#) of at least 800 m/s (Jenzen-Jones, 2019). See also: '[Small-calibre, high-velocity \(cartridge\)](#)'.

Smokeless powder: Propellant that produces less residual carbon when burned than traditional [black powder](#). Usually more efficient, and hence produces higher [muzzle velocity](#) for a given [load](#) volume.

Smoothbore (barrel): A [barrel](#) which is not [rifled](#), such as that found in a typical [shotgun](#). In [light weapons](#) and [artillery guns](#), projectiles fired from smoothbore barrels are often stabilised by fins to ensure that they fly accurately and point-first. Also 'non-rifled'; 'unrifled'.

Squad (infantry): A small unit of infantry typically led by a non-commissioned officer, and generally numbering between six and twelve individuals. Infantry squads are normally equipped primarily with [small arms](#) and limited quantities of [light weapons](#).

Stock:

1. The support structure of a weapon (traditionally a [firearm](#)) into which the [barrel](#) and [action](#) are set. Where applicable, includes the [buttstock](#) that is braced against the user's body (typically the shoulder) when firing.

2. (*Colloquial*) Shortened form of 'buttstock'.

Striker: A weapon component responsible for impacting the [primer](#) in a [munition](#), firing the weapon. The striker operates in a linear fashion and impacts the primer directly. See also: '[Hammer](#)'; '[Firing pin](#)'.

Stripper clip: See '[Charger clip](#)'.

Sub-machine gun: A [self-loading long gun](#) chambered for a [handgun cartridge](#) and capable of [automatic](#) fire.

Subsonic: An object travelling below the speed of sound in air. This varies according to atmospheric conditions (especially air pressure), but at sea level is approximately 340 m/s.

Surface-to-air missile (SAM): A [guided missile](#) designed to be fired from the ground to engage an aerial target, such as a fighter aircraft or unmanned aerial vehicle. See also: '[Man-portable air defence system \(MANPADS\)](#)'.

Surface-to-surface missile (SSM): A [guided missile](#) designed to be fired from the ground to engage ground targets such as personnel, vehicles, and structures. See also: '[Anti-tank guided missile \(ATGM\)](#)'.

Support hand: The hand employed by the user of a weapon to provide additional stability and to maintain proper sight picture and alignment. This is usually a user's non-dominant hand (e.g., the left hand, in the case of a right-handed user). See also: '[Control hand](#)'.

Trigger: A common component of a weapon's [firing mechanism](#), which allows a user to directly interact with a weapon's [operating system](#). Typically absent from weapons which are fired remotely.

Trigger mechanism: A type of [firing mechanism](#) specific to weapons that are fired by means of a [trigger](#) (whether external or internal), consisting of the trigger itself and other fire control components.

Trigger pull (colloquial): The amount of pressure required to activate a weapon's [trigger](#).

Tripod: A mechanical [mount](#) onto which a weapon can be fitted to absorb [recoil](#) and provide stability. Typically tripods have three legs, as the word implies, but the term is also used colloquially for some four-legged mounts serving the same function.

Under-barrel grenade launcher (UBGL): A [light grenade launcher](#) which can be fitted to a [small arm](#) as an [auxiliary](#) weapon.

Unguided (munition): A [munition](#) that, once fired or launched, cannot alter its [flight path](#).

Unrifled: See '[Smoothbore](#)'.

Weapon system: A [light weapon](#) or [heavy weapon](#) along with its [munitions](#) and [critical components](#) such as a [mount](#) or [launch platform, guidance system](#), power supply, or sighting system. Sometimes taken to include a weapon's host or towing vehicle(s). Increasingly, if unhelpfully, applied to [small arms](#) and their [accessories](#). Distinct from a 'weapons system', which is a system integrating and/or controlling multiple weapons or weapon systems.

Windage:

1. The difference in diameter between a gun's [bore](#) and the diameter of the [projectile](#).
2. (*Colloquial*) Any lateral shift in the point of impact, and the sight adjustments required to align the point of aim with the point of impact.

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